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THE RAJPUTANA DESERT*

THE RAJPUTANA DESERT is located in the Rajasthan Province in the north-western part of India. It has an area of about 1,30,000 sq. miles with a total population of 15·3 millions.

For practical purposes Rajasthan may be divided into two major divisions: north-west of the Aravalli Hills, an arid and semi-arid area with average rainfall of 4" or less in the west; gradually increasing to the east and south-east to about 14" at Jodhpur, and still higher in the Aravalli Hills. Nearly 80-87 per cent. of the annual rainfall comes during the monsoon months of June-September. These are also months of high relative humidity. There is also widely varying rainfall from year to year and severe droughts every few years. For example, at Jaisalmer rainfall varied from none whatsoever in one year to over 22" in another with an average of only 7". At Bikaner it varied from 1·1" to over 30" and less than 12" average. Temperatures are moderate in winter and reach 120° F. or more in May and June, the two hottest months. "There is a constant breeze from the south-west to the north-east during the greater part of the year from February to October with a velocity of 8-10 miles per hour. The velocity increases during May to 20 miles per hour.....The winds have a desiccating effect." (p. 226.) Mean monthly evaporation varies from 6-10" for such months as November-February to 20" or more during May and June, the hottest months. Soils are mostly sandy but become more clayey as one approaches the Aravalli Hills.

For a desert area, the population is rather high. Around Jaisalmer there are 4 persons per square mile. Around Bikaner there are 28 per square mile. These are undoubtedly largely concentrated in towns and villages.

South-east of the Aravalli Hills, the second major division, the area is not truly a desert. Annual rainfall is generally over 25", there are some forest areas and much of the land is suitable for cultivation.

* Critical Review of the Proceedings of the Symposium on the Rajputana Desert, held in New Delhi, during March 1952, published as *Bull. National Inst. Sci., India*, 1952, No. 1, pp. 302.

Is the Desert Expanding ?

There is some difference of opinion as to whether the desert is actually encroaching on adjacent areas. Some believe that it is extending north-eastwards at the rate of ½ mile a year. M. S. Krishnan in his *Geological History of Rajasthan and Its Relations to Present-Day Conditions* states (p. 30): "Aridity gradually developed during the last 5,000 years, and with it, inland drainage and salinity of the waters." H. D. Sankhalia says (p. 48): "It is not unlikely that witnessing the increasing aridity, the population trend about the 3rd century B.C. or a little before was towards the habitation of the more fertile eastern zone."

S. K. Pramanik believes there is no change in weather over the last 70 or 80 years. On the other hand, S. K. Banerji, studying actual weather data at individual stations, finds a general downward trend in rainfall from about 1860-1920 and a continuing downward trend to 1940 in the area north-west of the Aravalli Hills, except at Jodhpur. In the area south-east of the Aravalli Hills, there was a downward trend to 1920, but not since.

M. B. Pithawalla (p. 147) says, "the most important cause is human interference, such as cutting down of forests in the upper reaches of the rivers, diversion of flood waters for irrigation, intensive grazing and destruction of dams and barriers". K. V. Krishnamurthy states that "the extension of desert conditions has not been due to the deterioration of meteorological factors but due to other causes". He quotes R. M. Gorrie (p. 133), "I think that the land adjoining the desert is not being engulfed by sand though it is slowly deteriorating as a result of increasing desiccation in south and south-western Punjab. It is, no doubt, difficult to distinguish between the land deteriorating as a result of desiccation and the land being engulfed by sand as a result of the advance of the desert".

Vegetation

There are shrubby trees in the Aravalli Hills. Generally, over the rest of the semi-arid area there is shrubby vegetation with sometimes an undergrowth of annuals and perennials. In the desert proper, there appears to be very little vegetation except some annuals during the rainy period. According to Shanti Swarup (pp. 223-32), most of the plants are annuals which come during the rainy season although there are some perennial shrubs and salt-tolerant plants, such as *Salsola fœtida* and *Altriplex cressifolia* in the salty areas and Tamarix along water-courses. Hem Singh Pruthi (p. 242) states that annuals appear shortly after the commencement of the rainy season and in years of good rainfall, normally cover practically the whole of available space. Their life is short, however, and they wither when the soil becomes dry as a result of the withdrawal of monsoon.

N. V. Kanithkar states that from available information it may be possible to grow crops with varying success when the rainfall is above 15". Below 15", crop growing is uncertain and below 10", it is likely to be a year of famine. However, Pruthi mentions cultivation of several species between the dunes which would appear to be in areas below 15" of rainfall.

Use of Native Vegetation

All statements regarding this indicate that it is excessive. There are such references as "wholesale destruction of forests", "intensive grazing" and "besides the damaging effects of livestock on vegetation, their owners cut down all foliage and/or collect foliage for use as fodder in the off season".

In addition to domestic livestock which undoubtedly migrate, there are also some wildlife and the desert locust. According to Pruthi, the desert locust "destroys the annuals and perennials, deavouring both leaves and bark leaving only woody portions behind".

Nevertheless, the livestock industry which is the main industry of the area, apparently is of importance to India. J. Banerji in discussing this (p. 279) emphasizes the manufacture of wool, woollen fabrics and blankets. He says the total sheep population is estimated to be 4 million with most of the wool exported. B. W. Ganguli (p. 275) says the Jumnapari goat is the pride of India, but it is reared under conditions which are disastrous from the long-range point of view.

Recommendations

Ganguli emphasizes the need for laws comparable to a number of Middle-Eastern laws aimed at controlling grazing. M. D. Chaturvedi recommends a Desert Research Institute Station at Jodhpur and a programme of afforestation. J. Banerji in discussing possible control states (p. 280) that "the 320 sq. miles of *Khalsa* area under the Forest Department are covered with open xerophytic scrubs and small trees, chiefly *Anogeissus pendula* (Dhok.), *Acacia catechu, Acacia leucophlœa, Cassia auriculata, Salvadora oleoides,* and *Prosopis spicigera*. Effective and continuous protection of these forests located on the slopes of the Aravallis, and their

management under a properly sanctioned working plan with control of grazing are essential, and will be possible through the local technically trained Forest Department". He discusses artificial regeneration procedures necessary for establishment and mentions that 163 trees, shrubs and herbs, 50 Indian grasses and 37 foreign grasses have been recommended by the Forest Research Institute at Dehra Dun.

F. R. Bharucha emphasizes the need for plant ecological research and especially the problem of succession of vegetation of the shifting dunes will have to be studied thoroughly.

It is somewhat surprising to see so little reference to the possibility of bettering the situation through management of the native forage that is now growing in the desert or to the need for range research. Controlled grazing would be but the first step.

U.S.A. Situation and Experience

It appears that the situation in the Rajputana is much like that which prevailed in the arid portions of the U.S.A., several years ago. At the end of World War I, for example, there were excessive numbers of cattle, sheep and goats on range lands of the U.S., partly as a result of the urge to expand herds during the war and accompanying high prices. Such excessive grazing over 30 or 40 years had brought about serious deterioration of the range resource, which, of course, was accentuated by droughts. I have actually seen in southern New Mexico, for example, the mesquite sand hill type (a very low producing type) extend ½ mile or more into what was valuable perennial grassland within 10 years. Climatic conditions there are nearly like those of the Rajputana Desert, less than 9" of rainfall annually on the average 55 per cent. or more coming in July, August and September when perennial grasses grow, frequent drought years and high evaporation. Other range areas in that same general locality were changed during three drought years (1916-18), with heavy stocking during the war, from valuable perennial grasslands having, it is true, a rather scant stand of grass, to land supporting only low value weeds and worthless half shrubs.

Accompanying the deterioration of vegetation there were many adverse results in excessive blowing of sand, loss of organic material in the soil and serious water erosion, especially of clay soils. As a result of less absorption of rainfall by soils, there was greater loss of water through surface run-off. This left less moisture available for plant growth. On clay subsoils, more moisture is required for production of the same quantity of dry vegetable matter by the vegetation. This has accentuated the adverse growth conditions and has further reduced production of forage. Thinner strands of vegetation have increased surface temperatures and the increased evaporation from the soil has led to additional loss of water without benefit to vegetation. Thus, the local and microclimate have changed adversely as vegetation deteriorated in the semi-arid and desert areas of U.S.A. having somewhat comparable annual rainfall. All of this has tended to result in a change to more drought-resistant vegetation, usually of less usability for livestock grazing.

With increased erosion, main drainage ways become clogged with soil washed from slopes. During rapid run-off following heavy storms, this greater quantity of silt gives greatly increased cutting power and erosion of sides of gullies. All of this means greater movement of sediments in stream courses and increased deposition in irrigation and other reservoirs.

Through research and experience, it has been found that such arid and semi-arid lands can be improved in native forage production through management; but the process is usually very slow, much slower than the rate of deterioration. This undoubtedly is due to less moisture being available for vegetation due to excessive run-off, more moisture required for the same vegetative production, lower fertility of the soils and other similar factors resulting from range deterioration which make natural growth more difficult, and all of these factors are accentuated during severe drought years. In order to bring about natural recovery, the vegetation must not be over-utilised and must be given a chance periodically to make normal growth. Since normal growth cannot be permitted over the entire range area, the "deferred and rotation system of grazing" has been developed to give the several portions of the range area a chance in turn to make full growth before being grazed at a suitable degree and under other sound phases of management.

There are many examples of recovery through application of improved range management in the U.S.A. The palatable forage, especially grass, has more than doubled in 4 or 5 years on experimental areas of sandy, desert lands of the Jornada Experimental Range of southern New Mexico grazed by cattle throughout the year under sound practices. Also winter sheep ranges on the desert experimental range of western Utah with about 7" of rainfall annually on the average, properly managed, produced 3 times as much forage as in their deteriorated condition within a ten-year period.

A deteriorated goat range in New Mexico having an average of about 12" of rainfall annually doubled its grazing capacity through effective seasonal degree of grazing, during a three-year drought period (1916-18) when rainfall was much below average and while many other range areas in the same locality were rapidly deteriorating under unwise use.

Through suitable management, including moderate grazing of perennial grasses each year, appropriate shifts of grazing and other suitable practices, the recovering vegetation can be grazed with increased production of livestock. On the Jornada Experimental Range, for example, production of beef from each cow carried has practically doubled during the past 20 years. The extreme variation in production between good and drought years has been narrowed. Also both sheep and goat production is greater under sound range management.

The situation and experience on range lands in the U.S. might have value in considering the situation in the Rajputana, although results in the U.S.A. would undoubtedly not have direct application.

Forest Division, W. R. CHAPLINE.
Food & Agric. Orgn. of the U.N.,
Rome.

WEALTH OF INDIA—RAW MATERIALS, VOL. III*

THE first volume of this encyclopædic work on the natural resources and industrial products of India appeared in December, 1948; the second was published towards the end of 1950.

The first two volumes were warmly received by the Press and the scientific circles, both in India and abroad. Handsome tributes were paid to the manner in which the work has been planned and executed, and to the format and neat printing of the volumes.

The third volume, just released for distribution contains articles under letters D & E and deals *inter alia* with about 600 species of economic plants, 3 minerals and 4 animal products.

In the case of botanical subjects, the scientific name of the genus forms the title of each article, and is followed by a brief account of the genus. The important economic species are described in the alphabetical order of their scientific names. After the title, the common English name, if any, and the standard references are given. Names in Indian languages are from regional floras and published lists of Indian names. No attempt is made to give a botanical description of either the genus or the species. The parts of economic importance, however, are described adequately. Where the species are of minor importance, a short generic note is considered sufficient. The distribution given is according to standard Indian floras. Purely ornamental or horticultural plants are not included.

For minerals and animal products, their common names have been found more convenient. Articles on minerals have been scrutinised by the Geological Survey of India. Occurrences have been listed in great detail, owing to the absence of precise information regarding reserves.

This volume also includes a valuable index to the regional, trade and common English and Indian names, found in the first three volumes.

* Published by the Publications Division, Council of Scientific and Industrial Research, India, 1952. Pp. xx + 236 + xxix. Price Rs. 18.

LADY TATA SCHOLARSHIPS AND GRANTS

THE Trustees of the Lady Tata Memorial Trust have announced the awards of Scholarships and Grants for the year 1953-54.

The International Awards of varying amounts (totalling £ 5,370) for research in diseases of the blood with special reference to Leucæmias are made to Doctors A. R. Gopal Ayengar (India), J. Kieler (Denmark), J. B. G. Dausset (France), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), C. Merskey (South Africa), Charles Oberling (France), R. Rask-Neilsen (Denmark), R. Robineaux (France), C. C. Ungley (England), J. Nordmann (France), N. A. Stenderup and F. Kissmeyer-Nielsen (on a joint research project) (Denmark).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. P. Venkateswarlu (Trivandrum), Rajaram Vasudeo Bhagwat (Bombay), P. R. J. Gangadharam (Bangalore), N. V. Bringi (Bombay), Dr. Purindra Nath Sen Gupta (Patna), Dr. (Mrs.) M. Aikat (Gwalior) and Miss K. S. Laul (Bombay).

DESIGN FOR A BRAIN

THE problem of how the brain functions in living organisms to produce the kind of behaviour designated as 'intelligent', 'purposeful' or 'adaptive' is one to which much attention has not been directed so far. While it is not disputed that the brain, whether in man or the lower organisms, resembles a machine in many ways, many workers believe that a mechanical model, however intricate, can never explain satisfactorily the capacity of the brain 'to learn by experience'.

In this connection, the volume *Design for a Brain** by Dr. Ross Ashby will be read with wide interest; for Dr. Ashby proceeds to show how a mechanical model can, in fact, be constructed having the capacity to adapt itself to the environment. In other words, the model reacts to external stimulii in such a fashion that its behaviour improves with each new experience. Naturally, only simple examples can be given at present exhibiting this capacity; even so, it is interesting to study in broad terms what the properties of such a system should be, subject to the known laws of mechanics, if it is to behave adaptively.

Dr. Ashby finds the solution in the existence of 'step functions' among the various parameters defining the behaviour of a system. While a large majority of the parameters are continuously variable, these step functions can take only specific values. For a particular value of a step function (S, say), the behaviour of the system with respect to the rest of the variables will appear to be independent of S, but if S changes by a discrete jump to a new value, the whole field of the other variables will be entirely altered. A physicist is strongly reminded in this connection of some of the concepts of quantum mechanics, such as eigen-values and stationary states.

Suppose it is arranged that S undergoes a transition only if the system is unstable with respect to the other variables, say, if one of the variables exceeds a given value. Then, for the new value of S, the system may be stable, the other parameters remaining unchanged. If not, S undergoes further transitions until a suitable value is attained for which the system is stable, and thereafter a small disturbance does not make it unstable and no further transitions take place. It is obvious that such a system is able to adapt itself without any further external influence, for the step function is automatically altered as a result of the first few encounters until the system reaches a stable condition. In other words, if the facility of altering step functions every time an instability is encountered is included in the design of the machine, it is able 'to learn by experience', and always attains a stable state, irrespective of what state is started from. Such a system is called an "ultra-stable system". Here again, Dr. Ashby makes a statement which is interesting: the speediest way of reaching the stable state is not through systematic changes in step functions, but through a *random* choice of the allowed values of the step function.

Dr. Ashby has in fact constructed an apparatus consisting of four magnets interacting with one another, which he calls a 'homeostat', illustrating many of the above principles. If arbitrarily disturbed, it always returns within three or four steps to a stable state, in which it continues to remain until it is disturbed again.

The essential difference between the principles of ordinary automatic control and the homeostat is best shown by the following example. The automatic pilot is a device which, amongst other actions, keeps the aeroplane horizontal. It is, therefore, connected to the ailerons in such a way that when the plane rolls to the right, it exercises a corrective action on them and rolls the plane to the left. The homeostat, if joined this way, may also do the same. Now connect the ailerons in the reverse way and compare the present behaviour of the two systems. Whereas the automatic pilot will tend to increase the roll after a small disturbance and persist in its action to the very end, the homeostat will do so only so long as the increasing deviations made the step functions start changing. Afterwards, it would take on suitable new values and start stabilising. It would then be ordinarily self-correcting with respect to disturbances.

Here are entirely new concepts, which have immense possibilities in physics and engineering, apart from their ability to explain the phenomenon of adaptation in living beings. As will be clear from the foregoing, the concepts are essentially mathematical, but Dr. Ashby has explained these in his book with remarkable clarity and elegance. In the first 200 pages, he has stated his thesis in plain words, aided by a number of diagrams and tables, and then reformulated them in precise mathematical form in an Appendix of 60 pages. However, the first part never lacks in precision or rigour, which

* *Design for a Brain*, by W. Ross Ashby. (Chapman and Hall), 1952. Pp. ix + 260. Price 36 *s*.

forcibly brings out the fact that mathematics is only a tool for simplifying the manipulation of ideas and that it leads to no new result unattainable by logical thinking.

Dr. Ashby has succeeded in showing that mechanical systems may be made to modify their behaviour according to the conditions met with. But in extending this idea to living beings, a few points need to be carefully considered. While it is true that an ultra-stable system is "goal-seeking", the goal has to be known even before the system is built up. For a mechanical system, it may be defined as that state in which the system is "stable". However, with living beings, the goal itself may vary according to circumstances. In such a case, it is quite possible that other types of special properties will have to be invoked for various parts of the system.

For instance, no method has been suggested in the book whereby an ultra-stable system can "learn" by experience, that is to say, how the adaptation to a particular environment from a general state can be made more rapid during a second or succeeding encounters. Obviously, a mechanism must be devised whereby the random choice of step function values is changed to *deliberate* choice if the same environment is met with once again. These are rather recondite points, which need be considered only in future developments of the theory. There is no doubt that the present book by Dr. Ashby is an outstanding contribution to the mechanistic explanation of the behaviour of living beings.

G. N. RAMACHANDRAN.

NRX, THE CANADIAN HEAVY-WATER PILE

THE NRX reactor at the Canadian Atomic Research Station at Chalk River has made possible a whole range of investigations in atomic energy and nuclear physics, not practicable elsewhere.

In reactors using natural uranium, the fast neutrons produced by the fission of the uranium 235 nucleus have to be slowed down to thermal energies to increase their chances of causing the fission of other uranium 235 nuclei, and the slowing-down process is achieved by the use of a 'moderating' material. In all existing reactors, the moderator is either graphite or heavy water. The American and British projects, with their emphasis on military uses, have concentrated on graphite-moderated reactors, which are most productive of plutonium. Canada, on the other hand, has been concerned with developing heavy-water reactors. The first, a low-power reactor known as ZEEP, gave the experience necessary for the construction of the second heavy water reactor, the NRX pile. The great advantage of using heavy water as the moderator instead of graphite is that it makes possible a smaller and more compact pile, and this means a pile with a higher neutron flux for a given power. The NRX pile, which was designed with power rating 10 megawatts, has a maximum neutron flux of 6×10^{13} neutrons/sq. cm./second, which is 10-20 times the flux in a graphite reactor of comparable size.

This very high neutron flux has made possible the commercial production of radio-active material in unrivalled concentrations, such as cobalt 60 which is produced by neutron irradiation of ordinary cobalt, and which is used as a substitute for radium in therapy and radiography because of its emission of penetrating gamma rays. It takes 18 months' irradiation in the high flux of the NRX pile to produce radiocobalt samples with a specific activity of 35 curies per gm. Pieces of irradiated cobalt, which have an effective strength of 1,000 curies a piece, have been made for Canadian hospitals and used in cancer therapy.

VPI CRYSTALS FOR PREVENTING RUST

DICYCLOHEXYL ammonium nitrite, known commercially as the Vapour Phase Inhibitor, or VPI, is being used to-day to protect such a variety of products as small machine parts, aircraft engines, wire, hand tools—even tiny watch parts and huge diesel engine crankshafts. It not only affords greater protection than previous methods of rust prevention, such as coatings of grease, but it also reduces cost and is more convenient to use. When a small steel part, such as a gear, is wrapped in a sheet of VPI coated paper, coated side next to the gear, the VPI slowly vapourizes and diffuses all around the part. Oxygen that was present when the gear was wrapped is thus effectively neutralised.

Its rust-prevention qualities were first discovered by the Shell Oil Company, U.S.A.

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THE MINIMUM VELOCITY OF PARTICLES IN DOPPLER DISPLACEMENT OF HYDROGEN

The light of canal rays of hydrogen which shows Doppler effect, consists mostly of light due to H_α, H_β, etc., of the Balmer series from neutral hydrogen atoms. The effect for H_α can be represented diagrammatically (Fig. 1) as a strip AB of varying intensity separated from the sharp line at *O*, which is H_α itself without change of wavelengtb (i.e., an undisplaced H_α line). The undisplaced line is given out by atoms of hydrogen gas in the space in which the canal rays are moving (since these particles are having velocities negligible compared to the very high speeds of the canal ray particles). Lower edge A represents the least displaced end of the Doppler strip and the wavelength displacement OA may, therefore, be represented as $d\lambda_1$ which gives the least velocity of particles of hydrogen represented in the canal-ray-beam. The maximum displacement $d\lambda_{max}$ is represented by B. Its behaviour has been extensively studied.[1] The present communication is concerned with the behaviour of $d\lambda_1$ of A with variation of the potential applied to the discharge tube producing the canal ray.

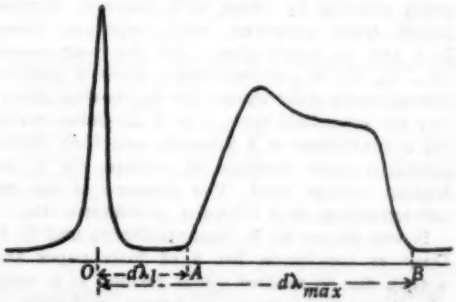


FIG. 1. Sketch of Doppler Displacement to show Undisplaced Balmer Line H_α at 'O' and Doppler strip 'AB' with Displaced Maximum at 'B' ($d\lambda_{max}$) and Minimum at 'A' $d(\lambda_1)$.

Steinheil three-prism glass spectrograph of high light-gathering power, *f*/3, and effective

base of 30 cm. was used. With a tele-objective attachment $f = 250$ cm. to the camera side, the dispersion was 11·92 Å/mm. In order to avoid complications from the background molecular lines and the continuum, we have made observation on H_α. Purity of gas in the discharge tube has been maintained by Wien's method of capillary streaming and continuous pumping.

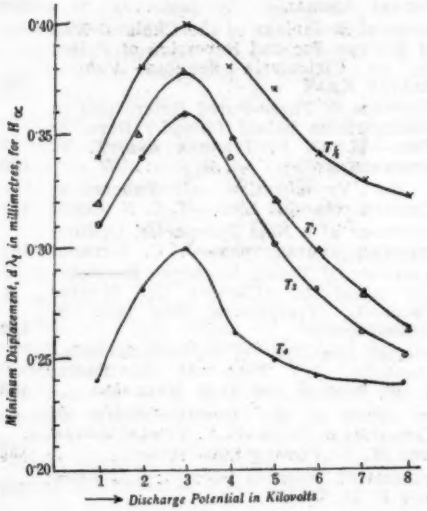


FIG. 2. Minimum Doppler Displacement for Hα.

Results are shown in Fig. 2. On one and the same plate, keeping time of exposure constant (say, 4 hours), photographs were taken at different discharge potentials from 1 to 8 kilovolts, varying by steps of 1 kilovolt. Similar plates were prepared with exposure times, 2, 1 and ½ hours also. All the four curves (T_4, T_2, T_1, $T_{1/2}$ respectively) show a uniform behaviour in their values for d_{λ_1} having first a rise for potentials from 1 to 3 kilovolts, reaching a maximum at 3 kilovolts and then falling gradually with increase of voltage, up to the highest voltage used. The pressure of the gas corresponding to 3 kilovolts is 0·09 mm. Hg.

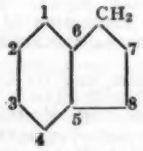
It was shown by B. Dasannacharya and G. K. Das,[2] as conclusion No. 9 of their paper that a strip due to neutral atoms formed as a result of dissociation from a heavy molecule of hydrogen of mass 4 exists, *only* in the voltage region, 1 to 3 kilovolts. The disappearance of this strip at 3 kilovolts can be regarded as the cause for a fall in the intensity of the lower limit of the Doppler strip, observed in the present result. Further details will be published elsewhere.

Dept. of Physics, M. SAKUNTALA.
Benares Hindu University, B. DASANNACHARYA.
March 17, 1953.

1. Dasannacharya, B. and Das, G. K., *Nature*, **1944, 154**, 21 ; — and Dakshinamurti, C., *Ibid*, **1944, 154**, 22 ; —, *Curr. Sci. Canal Rays Special Number*, 1937. 2. — and Das, C. K., *Phil. Mag.*, **1948, 39**, 966.

ELECTRONIC ENERGY LEVELS OF INDENE

THE electronic energy levels of the Indene molecule have been calculated by the method of antisymmetrised molecular orbitals. The structure of Indene is :



The assumptions made in these calculations are :

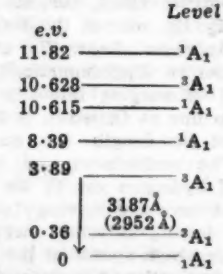
(i) Indene has eight π electrons which are responsible for spectroscopic levels ;

(ii) The molecular orbitals can be written down as follows :

$$\phi_l = \frac{1}{\sqrt{8\sigma_l}} \sum_{k=1}^{8} e^{\frac{2\pi i l k}{8}} K(\nu)$$

$$(l = 0, \pm 1, \pm 2, \pm 3, 4)$$

σ_l being a normalisation factor, K (υ) being the $2p\pi$ atomic orbital of the kth atom. The numbering of the atoms is indicated above.



(iii) The interaction between electrons, partially on non-neighbouring atoms as also that between electrons 1, 2, 3, 4, on the one hand and 7, 8 on the other, is negligible. Effect of the hydrogen atoms and the spin orbit interaction is neglected ;

(iv) The C = C distance is taken as 1·39 A.U.

Reckoning from the ground level, the energy levels in e.v. are shown in the adjoining diagram (not to scale). The observed bands at 2952 A.U. are assigned to the transition from $^3A_1$ (3·89) to the ground state $^1A_1$.

Full details will be published elsewhere.

Physics Department, S. RAMAMURTY.
Andhra University, Waltair,
May 15, 1953.

OCCURRENCE OF A HOLOSPORELLA IN THE NINIYUR GROUP (DANIAN) OF THE TRICHINOPOLY CRETACEOUS, S. INDIA

PROF. L. RAMA RAO collected some time back certain specimens of cherts from near Otakoil similar to those of the adjacent Niniyur group, and after a preliminary examination, pointed out that these specimens contained an extraordinarily rich abundance and variety of exceedingly well preserved Dasycladaceæ, including several new forms not described in the 1936 memoir.[1]

In the course of a detailed study by the author of these Dasycladaceæ, now under progress, the occurrence of Holosporella, similar to Holosporella siamensis of Julius Pia, has been noticed. Pia[2] first erected this new genus in 1930 to designate a primitive "endospore" Dasycladaceæ found in certain upper Triassic rocks from the Burmo-Siamese frontier. In sections of the Niniyur cherts now under study, a similar Holosporella occurs,—both longitudinal and cross-sections being noticed. These views are reproduced in Figs. 1 and 2.

FIG. 1. (× 50)

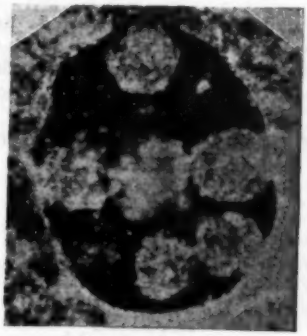


FIG. 2. (× 50)

In this connection, it may be pointed out that S. R. Narayana Rao and K. Sripada Rao have also recorded the occurrence of Holosporella *cf.* H. siamensis in the inter-trappean limestones (early Eocene) of the Rajahmundry area, and a description of this form was published in 1936.[3] The following table of comparative measurements of these 3 Holosporellas shows their general similarity:

Dimensions (in mm.) of	Holosporella cf H. siamensis S. R. N. Rao and K. S. Rao, 1936 from Rajahmundry	Holosporella siamensis Pia, 1930 from Siam	Holosporella, from Niniyur
Outer diameter of cylinder	about 0·51	about 0·4	about 0·30
Diameter of central perforation	,, 0·21	,, 0·15	,, 0·14
Diameter of globules	,, 0·12 to 0·15	,, 0·21	,, 0·10 to 0·14
Thickness of membrane	about 0·01	,, 0·01	about 0·01
Number of globules seen in cross-section	,,	,, 10	,, 8
Stratigraphical horizon	Early Eocene	Upper Triassic	Danian

Referring to the Rajahmundry occurrence, Pia said that "the existence of an endospore Dasycladaceæ in so high a geological horizon is quite unexpected a fact" and is "obviously

most perplexing". The present find of a similar Holosporella in the Danian Niniyur beds, is another example of such an unexpected occurrence.

The detailed studies of this and other Dasycladaceæ from Otakoil will be published elsewhere.

The author is thankful to Prof. L. Rama Rao for his valuable guidance, to Sri. M. G. C. Naidu for his helpful encouragement, and to Sri. M. M. Veerabadriah for assistance in photomicrographic work.

Dept. of Geology, S. SAMBE GOWDA.
Central College, Bangalore,
April 8, 1953.

1. Rama Rao, L. and Julius Pia, *Mem. Geo. Sur. Ind. Pal. Indica*, 1936, **21**, No. 4. 2. Julius Pia, *Rec. Geo. Sur. Ind.*, 1930, **63**, Pt. 1. 3. Narayana Rao, S. R. and Sripada Rao, K., *ibid.*, 1936, **71**, Pt. 4.

PYROPHOSPHATE COMPLEXES OF TIN AND ZINC

A NUMBER of metals form complexes with alkali pyrophosphates, but very little is known on the nature of these complexes. Rogers and Reynolds[1] have reported that zinc complexes with P_2O_7 : metal ratio of 2 : 1 as well as 1 : 1 exist in solution, and Haldar[2] mentions only the 2 : 1 ratio. No information appears to be available on tin.

In this investigation, complex formation with tin and zinc has been studied at room temperature by potentiometric and conductometric titrations of 0·100 M sodium pyrophosphate with 0·148 M zinc sulphate or 0·175 M stannous chloride (dissolved in the minimum quantity of HCl), and *vice versa*. For conductometric titrations, the solutions have been diluted 25 to 50 times. Antimony as well as glass electrodes have been used for the potentiometric method and the Kohlrausch bridge for the conductometric. There are two changes in the curves (potential-titrant ; conductivity-titrant) corresponding to complete precipitation of metal pyrophosphate (stannous or zinc) and formation of the complex. The ratio of P_2O_7 : metal corresponding to these changes, is 1 : 2 for tin and zinc, *i.e.*, $Sn_2P_2O_7$ and $Zn_2P_2O_7$ (precipitate), and 1 : 1 for tin and 2 : 1 for zinc respectively, *i.e.*, $[Sn(P_2O_7)]^{-2}$ and $[Zn(P_2O_7)_2]^{-6}$ (complex).

The metal ion concentration of tin and zinc in the pyrophosphate complex solutions has been determined by measuring the static potential of these metals in the solutions against a saturated calomel electrode. The range of composition of the solutions is: stannous pyrophosphate 20-60 g./l., sodium pyrophosphate 120-360 g./l., zinc pyrophosphate 40-60 g./l., sodium pyrophosphate 220-330 g./l. The tin ion concentration is of the order of 10^{-14} g. ion/l. (60° C.) and zinc ion concentration 10^{-7} g. ion/l. (42° C.). The instability constant K of these complexes has been calculated from the metal ion concentration and found to be of the order of 10^{-14} for tin and 10^{-7} for zinc. Haldar[2] has reported a value of the same order for K in the case of zinc.

The electroplating of tin and zinc from the complex pyrophosphate solutions has already been briefly reported by Vaid and Rama Char.[3,4]

Our thanks are due to Prof. K. R. Krishnaswami for his keen interest in the investigation.

Electro-Chemistry Lab., J. VAID.
Dept. of General Chemistry, T. L. RAMA CHAR.
Indian Institute of Science,
Bangalore-3,
April 10, 1953.

1. Rogers and Reynolds, *J. Amer. Chem. Soc.*, 1949, **71**, 2081. 2. Haldar, *Curr. Sci.*, 1950, **19**, 283. 3. Vaid and Rama Char, *Ibid.*, 1952, **21**, 310. 4. —, *J. Sci. and Ind. Research, India*, 1952, **11B**, 503.

ELECTRODEPOSITION OF COPPER-TIN ALLOYS FROM THE PYROPHOSPHATE BATH

COPPER-TIN alloy deposits are used in decorative and protective finishing of metals. Electrodeposited speculum containing 40-45% tin is silvery-white, hard and resistant to corrosion and tarnishing. The stannate-cyanide bath is employed for the commercial electroplating of copper-tin alloys,[1,2,3] and solutions of the oxalate type have also been studied.[4] The only reference to the use of the pyrophosphate-bath is to the old work cited by Bennett[5] which, however, gives no indication of the bath composition or the plating conditions.

Vaid and Rama Char[6] have shown that the complex pyrophosphate-bath is suitable for tin plating. Copper has also been successfully electrodeposited from the complex copper pyrophosphate-bath in this laboratory[7] as well as elsewhere.[8,9] As both the metals form complexes with pyrophosphate, this bath appears promising for co-deposition. Cathode potential measurements of copper and tin in pyrophosphate solutions confirmed this possibility.

The plating bath contains copper pyrophosphate, stannous pyrophosphate, sodium pyrophosphate and disodium hydrogen phosphate. The latter helps in preventing the tendency of the bath to precipitate after sometime (about 3 hours). Table I shows the effect of variation of the c.d. and copper content of the electrolyte on alloy deposit composition.

TABLE I

Bath Composition: (i) *Stannous pyrophosphate 60 g./l., Sodium pyrophosphate 360 g./l.* (ii) *Copper pyrophosphate corresponding to copper content given below, Sodium pyrophosphate = 4 times copper pyrophosphate.* (iii) *Disodium hydrogen phosphate 20 g./l. Temperature, 60° C., Still, Cathode and Anode—platinum, pH : 8·6-8·7*

Copper content of solution g./l.	Composition of alloy deposit	c.d. amp./dm.²				
		0·39	0·55	0·70	0·85	1·09
4·77	Cu%	..	12	..	..	..
	Sn%	..	88	..	..	..
7·15	Cu	45	18	16	..	..
	Sn	55	82	84	..	..
9·54	Cu	89	41	26	22	22
	Sn	11	59	24	78	78
11·93	Cu	95	67	37	29	27
	Sn	5	33	63	71	73
14·40	Cu	95	70	44	33	..
	Sn	5	30	56	67	..

The copper content in the electrodeposit increases with increase in the copper content of the plating solution and decreases with increase in the c.d. At constant c.d., the percentage of copper increases with increase in temperature, decrease in total pyrophosphate content of electrolyte and by agitation.

Alloy deposits analysing 12-95% copper (88-5% tin) have been obtained by varying the operating conditions. The deposits (on copper, brass or platinum) are quite adherent, smooth, fine-grained and silvery-white, yellow to red in colour depending upon the ratio of copper to tin. With steel as basis metal, they are not as adherent. The throwing power of the solution is good and the deposits do not change in appearance during a period of 2 to 3 months in the laboratory atmosphere.

Our thanks are due to Prof. K. R. Krishnaswami for his keen interest in the investigation.

Electro-Chemistry Lab.,
Dept. of Gen. Chemistry, J. VAID.
Indian Institute of Science, T. L. RAMA CHAR.
Bangalore-3,
April 10, 1953.

1. Tin Research Institute (England), *Working Instructions for Speculum Plating*, 1952. 2. Singh and Siddhanta, *J. Ind. Chem. Soc.*, 1949, **26**, 471. 3. Faust, *Trans. Electrochem. Soc.*, 1941, **80**, 301. 4. Field and Weill, *Electroplating*, Chapter 23. 5. Bennett, *Trans. Electrochem. Soc.*, 1913, **23**, 257. 6. Vaid and Rama Char, *Curr. Sci.*, 1952, **21**, 310. 7. Rama Char and Co-workers (*Unpublished work*). 8. Bandes, *Trans. Electrochem. Soc.*, 1945, **88**, 263. 9. *Electroplating*, 1948, **1**, 523.

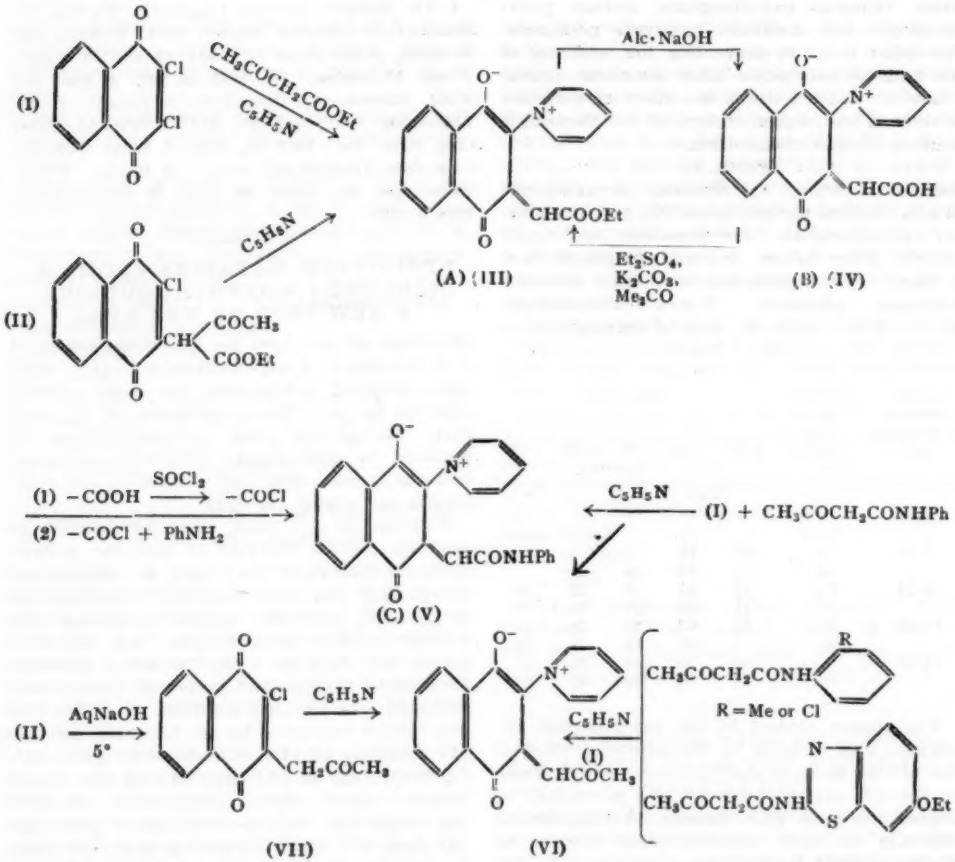
PYRIDINIUM BETAINES FROM 2:3-DICHLORO-1:4-NAPHTHOQUINONE: A NEW TYPE OF VAT DYES

SYNTHESIS of vat dyes by the condensation of 2 : 3-dichloro-1 : 4-naphthoquinone (I) with azoic coupling components has been recently reported by us.[1] The condensation of (I) with ethyl acetoacetate and acetoacetarylides in pyridine to give deeply coloured pyridinium betaines is now described. Some of the compounds are useful vat dyes.

Reaction of (I) with ethyl acetoacetate in alcoholic sodium ethoxide to give the yellow-coloured compound (II) and a red-coloured bye-product has been reported.[2] Condensation in pyridine, however, yielded compound (A) (orange needles from ethanol, m.p. 154-55°), which was different from the above products. Elementary analysis and properties (*vide infra*) indicated that (A) is constituted as (III). This was further confirmed by the following facts:— (1) Reaction of (II) with pyridine gave (A). (2) Hydrolysis of (A) gave an acid (B) (violet needles from acetic acid, m.p. 307-08°). (3) Acid (B) on re-esterification gave (A). (4) Acid (B) gave the anilide (C). (5) Compound (C) was also obtained along with (VI) from the reaction of acetoacetanilide with (I) in pyridine. Compounds (A), (B) and (C) are, therefore, unambiguously constituted as (III), (IV) and (V) (Chart I).

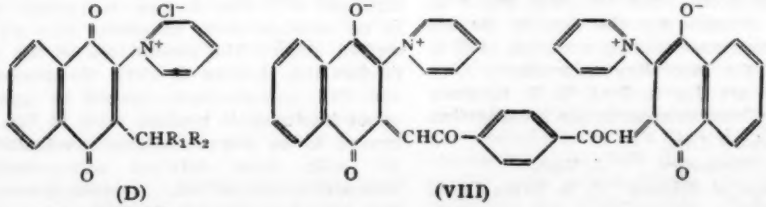
Condensation of acetoacetanilide with (I) in pyridine gave violet needles (pyridine), m.p. 255-57° and red needles (aq. pyridine), m.p. 203-05°. The former compound proved to be identical with compound (C) (V) described above. The constitution of the second product then follows as (VI). Compounds (V) and (VI) are obviously formed by hydrolysis of an intermediate product such as (D). This proved to be correct because condensation of (I) with three different acetoacetarylides: acetoacet-o-chloranilide, acetoacet-o-toluidide and 2-acetoacetamido-6-ethoxybenzthiazole (Naphtol AS-L4G), with (I) in pyridine gave

CHART I



a common reaction product which proved to be identical with the red compound described above. The constitution (VI) for the latter compound was thus confirmed. Further proof was obtained by an alternative synthesis of (VI) through (VII) (yellow needles from ethanol, m.p. 150-51°) (Chart I).

Condensation of (I) with Naphtol AS-LG [terephthaloyl-bis-acet (2 : 4-dimethoxy-5-chloro) anilide] and Naphtol AS-L3G [terephthaloyl-bis-acet (2-methoxy-4-chloro-5-methyl) anilide] in pyridine also gave a common reaction product (red needles from quinoline which do not melt up to 360°), which is



R_1 = –$COCH_3$
R_2 = H, –COOEt or –CONHPh

constituted as (VIII) on the basis of its elementary analysis and properties.

The above compounds represent a new type of vat dyes. Compounds (V) and (VI) dye pale pink shades, but (VIII) gives an attractive reddish orange shade on cotton from a bluish violet alkaline hydrosulphite vat (Fastness: Light, 6-7; Chlorine, 4-5; Severe washing, 4).

In view of the antimitotic activity of naphthoquinones[3] and their general physiological activity, the biological activity of the above and related compounds will be examined.

Further experiments in connection with this work are in progress and a detailed account will appear elsewhere. We are grateful to Professor Wilson Baker for helpful comments.

Dept. of Chem. Tech., University of Bombay, Bombay-19,
B. SURYANARAYANA.
B. D. TILAK.

February 17, 1953.

1. Tilak *et al.*, *Proc. Ind. Acad. Sci.*, 1953, **37A**, 81-103. 2. Michel, *Ber.*, 1900, **33**, 2402. 3. *Rep. Brit. Emp. Cancer Campgn.*, 1947-1951.

ROLE OF pH IN THE XYLENE EXTRACTION METHOD FOR THE ESTIMATION OF ASCORBIC ACID

IN the course of a study of the changes in ascorbic acid in canned fruit and fruit juices preserved with sulphur dioxide, we had occasion to employ the indophenol-xylene extraction method with suitable modifications to allow for interfering substances like sulphydryl compounds, reductic acid, reductones, stannous and ferrous salts.[1] Using formaldehyde and hydrochloric acid for condensation of sulphur dioxide, xylene to extract the excess dye and a Summerson-Klett photo-electric colorimeter to measure the intensity of the pink colour of the dye, it was observed that the scale readings decreased with time due to the fading of the colour. This occurred when the dye followed by the xylene was added directly to the sample of sulphited squash. In this case, acetate buffer was not added as in the usual procedure for the estimation of ascorbic acid by the xylene extraction method.

A detailed study of the rate of destruction of the pisk colour of the dye using a photoelectric colorimeter, 520 mμ filter and a number of reagents generally employed in the extraction of ascorbic acid and elimination of interfering substances, such as 2 per cent. metaphosphoric acid, 3 N sulphuric acid, 3 N hydrochloric acid, 8 per cent. acetic acid, 2 per cent. oxalic acid, etc., showed that the rate of destruction is very rapid with the higher concentration of the acids. The destruction of colour by 8 per cent. acetic acid was the least. The pH of the reaction mixtures ranged from 1·10 to 2·30. Using a reaction mixture of 5 ml. water, 2 ml. dye (1 ml. dye = 0·1037 mg. ascorbic acid) and 0·1, 0·25 and 1·0 ml. of 3 N HCl, at room temperature of 24° C., nearly half the colour was destroyed in 2, 1 and ½ minute respectively. The rate of destruction of the colour in citrate-phosphate buffers of range 3·0, 4·0, 5·0 was, however, very slow and was almost negligible during the first 3-5 minutes. The blue colour of the dye did not change to pink at pH 6·0. These results indicate the great importance of the adjustment of the pH of the reaction mixture in the xylene extraction method for the estimation of ascorbic acid, since during the interval between the addition of the dye to the sample and the subsequent addition of xylene to extract the remaining dye, however quick the additions may be, there is destruction of some of the dye, especially when the pH of the reaction mixture is below 2·0. At pH 3·0 to 5·0, there is very little destruction of colour during the first 30 to 60 seconds. It is, therefore, essential to adjust the pH of the reaction mixture to at least 4·0 for the estimation of ascorbic acid by xylene extraction procedure. Robinson and Stotz[1] also recommend the addition of acetate buffer of 4·0 to the sample. Our experiments have adduced independent evidence to indicate the importance of the adjustment of the pH of the reaction mixture to obtain correct values for ascorbic acid in preserved fruits and vegetables using the xylene extraction method. In the direct titration method, however, the interference by pH even at low ranges is negligible, especially when the dye is run from a burette into the sample.

Details of this investigation will be published shortly.

Division of Fruit Tech., C.F.T.R.I., Mysore,
G. S. SIDDAPPA.
BALDEV SINGH BHATIA.

March 19, 1953.

1. Robinson, W. E. and Stotz, E., *J. Biol. Chem.*, 1945, **60**, 217.

LAKSHADIA FICI GREEN, AND ITS COLOUR DIMORPHISM

KUMAR GUPTA[1] recently observed a lac insect on *Ficus religiosa*, showing red and yellow forms. The first to record such an observation

was Col. Adams who found it also on *F. religiosa*, at Marwar, in Rajputana, about 1896. The second record is from Monghyr, in Bihar, where Walsh had such lac collected again from *F. religiosa*, which ultimately induced Green to name the insect *Lakshadia* (*Tachardia*) *fici*. That was just before 1901. In 1925 I published a paper wherein the lac insect, cultivated in Kashmir on *Acacia catechu*, was identified as *L. fici*. In 1937, I[2] tried to show the identity of the Rajputana insect, subsequently illustrated by Negi of Ranchi, to be *L. fici* and the same as previously observed by Adams. Since the description of Green has appeared no other writer in India has used the designation *L. fici*. It is high time to point out what Sir G. Watt[3] wrote so clearly in 1901. "It is quite likely therefore that India may possess more than two species and that this circumstance may account for certain discrepancies in the observations of Indian writers that have puzzled practical planters." Other references to literature would be found in my paper.[2]

Dept. of Biochemistry, S. MAHDIHASSAN.
Cipla Labs., Bombay-8,
April 16, 1953.

1. *Curr. Sci.*, 1953, **22**, 49. 2. *Ibid.*, 1937, **6**, 159. 3. Watt, G., *Agri. Ledger. Lac and the Lac Industry*, 1901.

MICRO-DETERMINATION OF HYDROGENATION-IODINE NUMBER OF VEGETABLE OILS

HYDROGENATION-IODINE numbers (H.I.N.)[1] of ten vegetable oils as well as of maleic acid, monomethyl fumarate and methyl oleate have been determined using "Towers" micro-hydrogenation apparatus.

The experimental procedure consists in saturating the catalyst (10-15 mg.) suspended in glacial acetic acid (5 ml.) in one of the two reaction flasks having the side arm, the second flask serving to conduct the blank experiment with the solvent only. The material (10-20 mg.) under examination is weighed in a small tube and held in the side arm of the reaction flask out of contact with the solvent and catalyst inside. After the catalyst is saturated, the substance is dropped into the flask and the hydrogenation is carried out at room temperature until no more hydrogen is absorbed. In the case of tung oil, hydrogenation has been conducted at 50-60° C.[2] The amount of hydrogen absorbed at room temperature and atmospheric pressure is converted into standard conditions of temperature and pressure and H.I.N. calculated by means of the following equation:

$$\text{H.I.N.} = \frac{v \times 253{\cdot}84 \times 100}{22412 \times w}$$

v = volume of hydrogen absorbed in ml. at N.T.P.
253·84 = weight of two atoms of iodine
22412 = volume in ml. of 1 mol. of hydrogen at N.T.P.
w = weight of sample in gram.

The *hydrogenation-iodine numbers* thus obtained have been compared with the *iodine values* determined by Hubl's and Wijs' methods. In the case of the tung oil, only low *iodine values* could be obtained although the estimation has been repeated more than a dozen times.

The simplicity and reliability coupled with the possibility of working with micro-quantities should warrant wide use of this method for the determination of unsaturation in oils and fats.

Full details will be published elsewhere.

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Dept. of Organic Chemistry,
Indian Inst. of Science,
Bangalore-3,
March 30, 1953.

1. Kaufmann, H. P. and Baltes, J., *Ber.*, 1937, **70**, 2537. 2. Pack, F. C., Planck, R. W. and Dollear, F. G., *J. Amer. Oil Chemists Soc.*, 1952, **29**, 227.

A SUITABLE MEDIUM FOR THE ENRICHMENT OF YEASTS

ROUTINE methods present considerable difficulty in isolating yeasts from such natural habitats as the intestinal tract of normal human beings, ripening fruits, sea-water, etc. A new method has been found suitable for the purpose, the details of which are briefly indicated below.

Enrichment of the yeasts was accomplished by the use of a liquid medium of the following composition in gm. per 100 ml. of distilled water: $(NH_4)_2SO_4$, 0·05; KH_2PO_4, 0·05; $MgSO_4.7H_2O$, 0·01; $FeSO_4.7H_2O$, 0·002; $CaSO_4.2H_2O$, 0·001; yeast extract (Oxoid), 0·1; saccharose (even commercial sugar will do), 10. It is clear from the above composition that the high concentration of sugar, lack of organic nitrogen and the presence of acid phosphate in the medium would have an adverse effect on the development of most of the heterotrophic bacteria. Moreover, the application of the now widely used anaerobic glass-stoppered bottle enrichments further cuts down those aerobes which would find the medium less un-

favourable. It may also be mentioned here that incubation at 37° C. was found to be uniformly suitable for securing the results.

Ordinarily, two successive transfers of the originally inoculated bottles through the same medium kept under anaerobic conditions was found to be adequate; thereafter, the enrichment culture could directly be surface-spread on aerobic plates of 2 per cent. dextrose yeast extract agar (with mineral base only) or on the solidified enrichment medium itself to obtain well isolated colonies made up almost entirely of yeasts. The cultures so obtained could then be purified by any of the methods available for the purpose.

By the application of the above method, it has been possible to isolate yeasts from 23 of the 25 specimens of normal human fæcal matter examined[2]; likewise, 3 out of 5 trials made to isolate yeasts from the ripe fruits of *Achras sapota* L.[3,4] have also been successful. Correspondingly, only 7 times in the former and only once in the latter case did the routine culture method prove successful. Isolation of yeasts from the marine sources has also been found easy by this method as compared to the routine culture method[1] wherein mould growth tends to overwhelm that of yeasts and renders the isolation of the latter difficult or even sometimes impossible.

It is hoped that this method would be given a trial in other habitats wherein yeasts could be seen but not isolated with the ease with which they should be.

St. Xavier's College,
Bombay,
January 19, 1953.

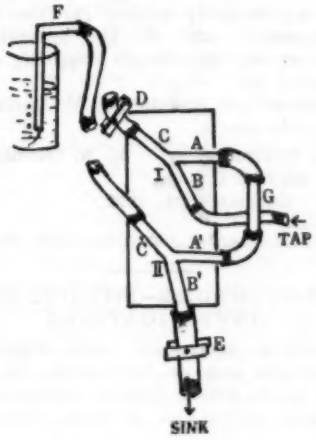
F. X. Lobo.
Suman Pathak.
Nafisa Kachwalla.
J. V. Bhat.

1. Kachwalla, N. *M.Sc. Thesis, Bombay University*, 1953, under preparation. 2. Lobo, F. X., *ibid., Bombay University*, 1950. 3. Pathak, S. M. and Bhat, J. V., *J. Univ. Bomb.*, 1952, **20**, Part 5, 14. 4. Pathak, S. M., *M.Sc. Thesis, Bombay University*, 1951.

A SIMPLE APPARATUS FOR AERATING NUTRIENT MEDIUM FOR ISOLATED ORGANS*

Dr. De[1] has described an apparatus for aeration of the nutrient fluids for isolated organs, especially, gut, uterus, etc. His recommendation of the substitution of air for oxygen is economical, particularly when a large number of experiments are to be conducted by students.

In this article, a simple apparatus is described which can be easily fitted up in any laboratory. The requirements are two glass Y-tubes (4 mm. and 5 mm.), a straight glass tube (4 mm. × 7·5 cm.), a 4-mm. thick, L-shaped glass tube, one end of which is drawn into a fine nozzle, two small screw clamps, a small wooden plank (8" × 1½" × ¼") with smooth surfaces and sufficient length of stout rubber tubing.



The Y-tubes (I and II) are arranged as shown in the figure, the smaller ones being placed above. The corresponding limbs of the Y-tubes are parallel to one another. The limbs A and A' are horizontal. The stems C and C' are at about 135° C. to the horizontal. The limb A is connected to the limb A' by rubber tubes with the straight tube (G) interposed. Limb B is connected to the water tap. Limb B' is the outlet for water and is attached to a rubber tube which is led to the sink situated at a lower level. This acts as a suction. The screw clamp (E) is attached to this rubber tube so as to regulate the flow of water outside into the sink, and this manœuvre, in turn, regulates the flow of air into the limb C'. A short rubber tube with screw clamp (D) is attached to the limb C. This screw clamp helps to adjust the air vent. The limb C' is attached to a long rubber tubing to the other end of which is attached the L-shaped tube (F), through which air is bubbled into the nutrient fluid.

By adjusting the two screw clamps, the amount of water let into the limb B, and the tilt of the plank to the vertical, most of the air can be made to pass through the limb C' with very little of water being carried over with it to contaminate the nutrient fluid. The

same purpose is served by having a larger Y-tube for II. If needed, a small bulb may be blown at the junction of A', B', C'. The draught of air in the straight tube is adjusted by the inflow, screw clamp D and the tilt of the plank. Once this is adjusted, it should not be varied. The number of bubbles can be varied by adjusting the screw clamp E.

The advantages of this apparatus are: (1) It can be easily made; (2) The aeration is continuous; and (3) The apparatus may be used in any experiments requiring constant bubbling of air.

My thanks are due to Dr. V. Iswariah for his valuable advice.

Dept. of Pharmacology, M. N. GURUSWAMI.
Madras Medical College,
Madras, *December* 24, 1952.

1. Dr. P. De, *Ind. Med. Gaz.*, June 1952, **87**, 247.

ADRENOCHROME—PHYSIOLOGICAL INVESTIGATIONS

THE various therapeutic uses claimed for adrenochrome and its derivatives, led to our present work, which aims at explaining their therapeutic actions on a sound physiological basis.

In a few preliminary experiments with dogs (anæsthetised with paraldehyde), the animals were found to stand intravenous doses upto 20 mg. per kilogram body-weight, without appreciable alterations in blood pressure and cardiac rate. When adrenochrome was perfused through isolated heart of kitten, there was, however, a lowering of the heart rate and the amplitude suggesting a parasympathomimetic action.

The effect of adrenochrome on isolated segments of intestine of kitten was studied by suspending the segment in Ringer-Dale solution in an apparatus similar to Dale's bath and recording the movements (Fig. 1). The effect was compared with those obtained with acetylcholine and adrenaline. When dilute solutions of adrenaline (1 in 10 million) was used in the bath, the relaxation of the muscle during the first three minutes was followed by an acetylcholine-like response. With a solution of adrenochrome (1 in 100,000), the acetylcholine-like response was obtained within 30 to 45 seconds without the preliminary relaxation noticed with adrenaline. If, along with adrenochrome, choline chloride, hexose-monophosphate or sodium pyruvate was added to the bath solution, the acetylcholine-like response became more marked. Similar findings noticed by Minz and Plotka,[1,2] were explained by them as being due to the formation of acetyl radicals from carbohydrate breakdown products uniting with the choline in the intestinal tissue leading to the formation of acetylcholine. They detected the presence of acetylcholine formed in the bath fluid by the contractions produced in the dorsal muscle of leeches, pre-treated with physostigmine. The present authors, however, perfused the fluid through the isolated heart of kitten to detect the presence of acetylcholine. It was also noticed by the present authors that the addition of acetylcholine along with adrenochrome led to greater increase in the tone of the muscle and the activity also lasted longer than with either of the compounds added separately, thus resembling the effect of eserine when added with acetylcholine.

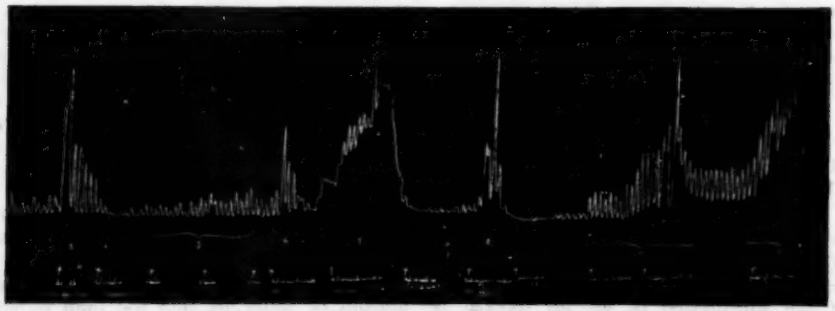


FIG. 1. *Effect on Intestinal Movements.* 1. Acetylcaoline (1 in 10 million); 2. Adrenaline (1 in 10 million); 3. Effect of adrenaline after 1 min., 2 mins., and 3 mins.; 4. Adrenochrome (1 in 100,000); 5. Adrenochrome and Choline Chloride; 6. Adrenochrome and Sodium Pyruvate; 7. Adrenochrome and Acetylcholine (1 in 100 million) and 8. Acetylcholine (1 in 100 million) and Eserine (1 in 10,000).

These results suggest that the acetylcholine-like effect seen at the end of three minutes with adrenaline is due to the formation of acetylcholine in the intestinal wall and that the compound responsible for that formation is adrenochrome, derived from the oxidation of adrenaline. The fact that adrenochrome is structurally related to rubreserine (a physostigmine breakdown product), which also has an inhibitory action on choline esterase activity, suggests that adrenochrome brings about this acetylcholine-like effect, not only by the production of acetylcholine in the walls of the intestinal tissue, but also by inhibition of choline esterase activity.

The clinical application of adrenochrome as an A.C.T.H. stimulator *in vivo* has been recently published by one of us (V. S.) the *Lancet*[3] and a comment on the same by Van Cauwenberge and Lecomte[4] also appeared in the same journal in January, 1953.

Further work is in progress.

Dept. of Physiology, V. SRINIVASAN.
Madras Medical College, P. I. GEORGE.
Madras, D. V. S. REDDY.
February 14, 1953.

1, Minz and Plotka, *Compt. rend. soc. biol.*, 1947, **141**, 108. 2. —, *Arch. Sci. Physiol.*, 1947, **1**, 19. 3. Srinivasan, *Lancet*, October 4, 1952, 684. 4. Van. Cauwenberge and Le Comte, *Lancet*, January 10, 1953, p. 98.

NUTRITIONAL REQUIREMNTS OF *PASTEURELLA SEPTICA*

VERY little information is available in the literature about the growth requirements of *P. septica*. Berkman[1] reported that several strains grew on a hydrolysed gelatin medium, when nicotinamide and pantothenic acid were added. Jordan[2] observed that, besides these two factors, thiamine was essential for the mouse strain of *P. septica* investigated by her. Working at this Institute, Das and Rawat[3] found that two Indian strains of the organism failed to grow in a casein hydrolysate medium containing nicotinamide, pantothenate and certain other growth factors and that the addition of serum or an extract made from liver, kidney or muscle was necessary. The present investigation has shown that these biological products can be replaced entirely by synthetic growth factors. Further, all the factors have been classified into three groups, *viz.*, essential, stimulatory and dispensable on the basis of these studies.

The basal medium consisted of the following ingredients per 100 ml.: glucose, 1·0 g.; acid hydrolysate of purified casein, 2·0 g.; sodium chloride, 1·0 g.; potassium phosphate (K_2HPO_4), 1·0 g.; ammonium chloride, 0·6 g.; sodium acetate, 0·2 g.; magnesium sulphate, 0·16 g.; ferrous ammonium sulphate, 8 mg.; histidine, proline, phenyl-alanine, cystine and tryptophane, 10 mg. each. Each tube contained 2·5 ml. of basal medium and the total volume was made up to 5 ml. by the addition of growth factors and the necessary amount of distilled water. The accessory growth factors were added so as to give the following final concentrations (per 100 ml.): nicotinamide, calcium pantothenate, thiamine and riboflavin, 0·2 mg. each; pyridoxin and *p*-aminobenzoic acid, 0·1 mg. each; folic acid and vitamin B_{12}, 4 µg. each; adenine, guanine, uracil, xanthine, inositol and choline, 1 mg. each; glutamine, 0·8 mg.; hæmatin, 0·5 mg.; biotin, 1 µg.

Glutamine was sterilized by filtration. In other cases, sterilisation was effected by autoclaving at 15 lb. for 20 minutes. The reaction of the basal medium and of the supplements was adjusted to pH 7·5 before sterilization. Of the test organisms studied, *Past* 52 is a virulent

TABLE I

Classification of the growth factors for P. septica

Strain	Essential	Stimulatory	Dispensable
P. 52	Pantothenic acid and nicotinamide	Adenine, uracil, guanine, xanthine, glutamine, inositol, pyridoxin, *p*-aminobenzoic acid, vitamin B_{12}, folic acid, choline, biotin and hæmatin	Thiamine and riboflavin
P. 25	Pantothenic acid, nicotinamide, adenine and uracil	Guanine, xanthine, glutamine, inositol, pyridoxin, *p*-aminobenzoic acid, vitamin B_{12}, folic acid, choline, biotin and hæmatin	Thiamine and riboflavin

bovine (vaccine) strain and *Past* 25 is "avirulent". The virulence of *Past* 52 is being maintained by passaging it in hill bulls every three months. About 6,000 viable cells were employed in inoculating 5 ml. of the test media. The complete mixture was found to give better growth than plain broth. The indispensability or otherwise of the individual growth factors was determined by omitting them singly from the complete medium. In every experiment, three tubes were used for each treatment, one tube being left uninoculated. The tubes were incubated aerobically at 37° C. for 48 hours.

Growth was evaluated by estimation of the turbidity of the culture tubes after incubation. The turbidity was determined by Lumetron photoelectric colorimeter (Model 401-A) using filter 650. Uninoculated complete medium was used as blank. The results presented in Table I were based on the data of at least three experiments with each strain.

The authors' thanks are due to Shri. M. R. Dhanda, Head of the Division of Pathology and Bacteriology, for his kind interest throughout this investigation.

Indian Veterinary Res. Inst., Mukteswar-Kumaun, *September* 19, 1952.

T. P. BANERJI.
R. MUKHERJEE.

1. Berkman, S., *J. Inf. Dis.*, 1942, **71**, 201. 2. Jordan, R. M. M., *Br. J. Exp. Path.*, 1952, **33**, 36. 3. Das, N. B. and Rawat, J. S., *Sci. and Cult.*, 1947, **13**, 160.

A NEW INTERSPECIFIC CITRUS HYBRID

AMONG Citrus fruits, the citron *Citrus medica* and the acid lime *C. aurantifolium* have been in cultivation in India and the neighbouring countries from very ancient times. The lemon *C. limonia* is closely related to the citron and was included as a variety of *C. medica* by Linneas and by botanists like Roxburgh, Hooker and Brandis. It probably arose as a hybrid between the citron and the lime in Western India, and spread to the Mediterranean countries in the early centuries of the Christian era. Like the citron, it has purple tinted flowers and petioles that are not winged. The flowers of the lime are like those of the orange, white, in colour. It has winged petioles. There are, however, many intermediate forms between the lime and the lemon. One such is the "Malta lemon" (Fig. 1), sometimes incorrectly called "Malta lime". According to Bonavia (1890), the Malta lemon was introduced by him into Lucknow in 1863. Malta lemon was introduced into Malabar from Burma by Sri. E. K. Raghavan in 1931.

It produces fruits all the year round, often in bunches of four and five, and is thus a heavy yielder and a most useful plant for the small gardens of Malabar. Seedless parthenocarpic fruits are the rule, but occasionally seeds are produced by open pollination.

Interspecific hybridization is a very common feature in the genus Citrus and has been responsible for the origin of many varieties which have been given the status of species by modern botanists. One such is the grape fruit *C. paradisi* which arose in the West Indies about 1814 as a hybrid between the sweet orange *C. sinensis* and the pommello *C. grandis*. To-day there are many named varieties of this popular breakfast fruit of the New World. They include diploids $2n = 18$, triploids $2n = 27$, and traploids $2n = 36$ (see *Chromosome Atlas of Cultivated Plants*, by C. D. Darlington and E. K. Janaki Ammal). Another natural hybrid of importance is the Rough lemon, *C. karna*, which has become the universal stock plant in Citrus industry. It is considered to be a hybrid between the Sour Orange—*C. aurantium* and the lemon.

The giant "Mitford lemon" of Kew Gardens is probably also another interspecific hybrid between the lemon and perhaps the pommello (*C. grandis*). It is a diploid ($2n = 18$). I collected Citrus fruits which closely resembled the "Mitford lemon" from Nepal in 1949. Seedlings of these are being grown at Kew for comparative studies.

Citrus hybrids come true from seeds because of the occurrence of vegetative embryony, a phenomenon very prevalent in the family Rutaceæ. Chance embryos which are produced sexually give interesting segregates, from which new varieties are constantly evolving for selection by the Citrus breeder.

Thus, great possibilities lie before the plant breeder who wishes to develop hybrids between species of Citrus, as shown by the work of Swingle in America. Names like "Citrange" for the frost-resistant hybrid between the sweet orange and trifoliate orange (*Ponciris trifoliata*); "tangelo" (tangerine × grape fruit or "pomelo"); "tangor" (tangerine × orange) have crept into horticultural usage (Bailey, 1933). To these I add "Citrolemon" for a natural hybrid between the citron and "Malta lemon" which I found growing amongst a collection of both these plants in the garden of Sri. K. Sukumaran at Kausthubham, Shoranur, South Malabar.

The hybrid is intermediate in size between the citrus and Malta lemon (Fig. 1).

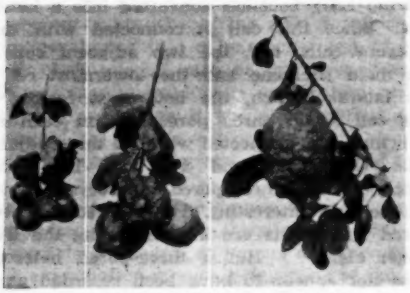


FIG. 1. Malta lemon (*left*); Citron (*right*) and the Hybrid (*centre*).

It has inherited the thick sweetish rind of the citron, and can therefore be used for the same purpose of candying and pickling as the citron. It resembles the Malta lemon in the production of fruit in bunches, four and five being common. Fruit exhibited at the local horticultural show received an award of merit. Cytological examination showed that both parents and the hybrid are diploid ($2n = 18$).

Seed production is very abundant in the hybrid and seedlings are being grown for genetic analysis and the production of tetraploids by colchicine treatment. I have given the name "Sukumari" to this useful Citrus hybrid.

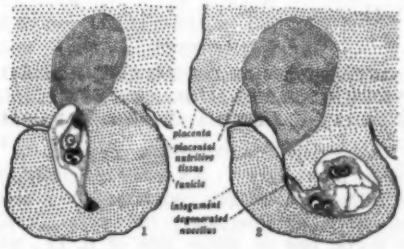
Botanical Survey of India, E. K. JANAKI AMMAL.
Calcutta,
April 18, 1953.

1. Bailey, L. H., *The Standard Cyclopedia of Horticulture*, New York, 1933. 2. Bonavia, E., *The Cultivated Oranges and Lemons of India and Ceylon*, London, 1890.

HAUSTORIAL BEHAVIOUR OF THE CHALAZAL END OF EMBRYO SAC AND REVERSION OF POLARITY IN *UTRICULARIA FLEXUOSA* VAHL.

IT is well known that the micropylar end of the embryo sac in *Utricularia* behaves as a haustorium. *Utricularia flexuosa*[1] resembles other species of the genus in this respect. The ovules, which are unitegmic, tenuinucellate and anatropous, are so oriented that the micropyle is directed towards the placenta. The apical end of the embryo sac, which develops according to the Polygonum type,[1] enlarges very rapidly. When the embryo sac is still at the four-nucleate stage of development, or even earlier, it becomes naked due to the disappearance of the nucellar cells. The young embryo sac grows through the micropyle, extends beyond the ovule and comes in contact with the placenta. Later, its apical end is seen to have penetrated deeper and lies embedded in the placental nutritive tissue which is situated at the base of each ovule[1] (Fig. 1).

In one ovule, however, the condition observed was just the opposite of the usual. Although the embryo sac had attained the four-nucleate stage, its micropylar end was not enlarged. The degenerate remains of the nucellus, which are not seen at this stage, were still present, forming a cap at the micropylar end of the sac. This is obviously due to lack of enlargement of the upper end of the sac in this case. On the other hand, the chalazal end, which is usually small and narrow (Fig. 1), had become



FIGS. 1–2. *Utricularia flexuosa*. L. s. of ovules. A part of the placenta is included to show the placental nutritive tissue (densely shaded area) at the base of the ovules. Fig. 1. Ovule with mature embryo sac, showing haustorial behaviour of the micropylar end. Fig. 2. Ovule showing the four-nucleate stage of an embryo sac, the chalazal end of which has grown into the funicle and has become higher than the original upper end. × 210.

extraordinarily enlarged. It had become curved and was seen extending towards the placental nutritive tissue through the funicle. It had advanced to such an extent that it was now situated at a higher level than the original upper end of the embryo sac (Fig. 2). This indicates that, in exceptional cases, the embryo sac may enter the placental nutritive tissue through the funicle instead of following the usual course. Although the embryo sac is only at the four-nucleate stage, the behaviour of the lower end recalls the condition in plants belonging to the Balanophoraceæ[2,3,4] and the Viscoideæ.[4–8] A strong probability is suggested that the reversion of polarity, seen at the four-nucleate stage in *U. flexuosa*, might have

extended to the mature stage of the embryo sac by the organization of the egg apparatus in the end which is now upper, but which was originally the lower or the chalazal end.

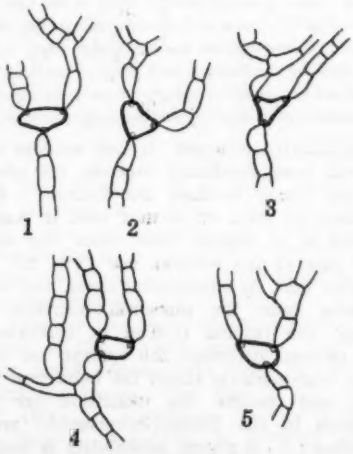
I am thankful to Mr. R. K. Bhattacharya, who prepared the slide from the material provided by me.

Dept. of Botany, REAYAT KHAN.
Aligarh Muslim University,
Aligarh, U.P.,
December 21, 1952.

1. Khan, Reayat, Unpublished Ph.D. Thesis, Delhi 1952. 2. Fagerlind, F., *Svensk Bot. Tidskr.*, 1945, **39**, 65-82. 3. —, *Ibid.*, 1945, **39**, 197–210. 4. Maheshwari, P., *An Introduction to the Embryology of Angiosperms*, 1950, New York. 5. Rutisbauser, A., *Ber. schweiz. bot. Gesell.*, 1935, **44**, 389-436. 6. —, *Ibid.*, 1937, **47**, 5-28. 7. Steindl, F., *Ibid.*, 1935, **44**, 343–88. 8. Schaeppi, H. and Steindl, F., *Vrtljschr. naturf. Gesell. Zurich*, 1945, **90**, 1–46.

OCCURRENCE OF THREE-PORED HETEROCYSTS IN *BRACHYTRICHIA BALANI* (LLOYD.) BORN. & FLAH.

IN the genus *Brachytrichia* heterocysts are usually intercalary. An ordinary intercalary cell in the trichome gets converted into a heterocyst. Such an intercalary heterocyst develops two pores, one on either side of it, i.e., where the former cell which got converted into a heterocyst was connected with its two adjacent cells of the trichome.



FIGS. 1–5. Filaments of *Brachytrichia Balani* showing three-pored heterocysts (× 640).

In some material of *Brachytrichia Balani* collected from Pamban, sometimes a cell in the main trichome which forms a branch (*branch-bearing cell*) becomes converted into a heterocyst. Since this cell is connected with three adjacent cells, *viz.*, the two adjacent cells in the main trichome and the lowermost cell of the lateral branch, the heterocyst formed by this cell shows three pores one on each side on which it is connected with the three adjacent cells (Figs. 1-5 and Fig. 6). The occurrence of such three-pored heterocysts is very unique and interesting. One-pored and two-pored heterocysts are known among the Blue-green algæ.[1,4] But a three-pored heterocyst does not appear to have been recorded among any of the Blue-green algæ. Several cases of three-pored heterocysts were found in the writers' material. These do not otherwise differ from the normal heterocyst of the alga, and have the same structure and appearance.

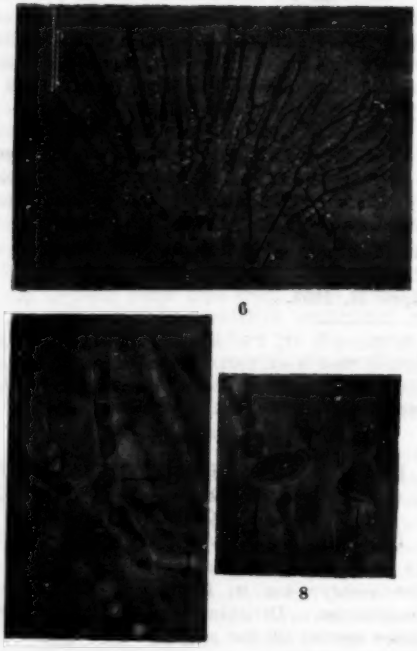


FIG. 6. Photomicrograph of a part of a thallus showing two-pored (*a*) and three-pored (*b*) heterocysts (× 220).

FIGS. 7, 8. Photomicrographs of two-pored (*a*) and three-pored (*b*) heterocysts (× 865).

They have a two-layered wall, the outer being thick and the inner quite thin. The nature of

the contents was normal and did not show any peculiarity. It may be stated here that in view of the fact that any normal vegetative cell can get converted into a heterocyst, there is nothing to prevent a branch-bearing cell of a trichome from developing into a heterocyst and forming three pores one on each of the three sides on which it is connected with its adjacent cells.

In this connection it would be interesting to note that in *Loriella osteophila* Borzi some of the heterocysts are formed at the point of forking (Ref. 2, Pl. VI, Figs. 1-5). This heterocyst would appear from the figures to be in contact with adjacent cells on three sides. But the heterocysts are shown as having only two pores. A re-examination of such heterocysts of the alga from this point is indicated. This alga has so far been recorded only from Papua.[3,5]

University Botany Lab., M. O. P. IYENGAR.
Madras, T. V. DESIKACHARY.
May 13, 1953.

1. Bharadwaja, Y., "Some aspects of the Myxophyceæ—Presidential Address to the Section of Botany," *Proc. Ind. Sci. Congr.*, Madras, 1940, Pt. II, 163-214. 2. Borzi, A., "Studi sulle Mixoficee–II: Stigonemaceae, *Nuov. Giorn. Bot. Ital.*, 1916, N. S. **23**, 559-88. 3. Fritsch, F. E., *Structure and Reproduction of Algae*–II: Cambridge, 1945, p. 848. 4. —, "Heterocyst, a botanical enigma—Presidential Address to the Linnean Society," *Proc. Linn. Soc.*, London, 1950, **162** (2), 194-211. 5. Geitler, L., *Cyanophyceae*, in Rabenhorst's *Kryptogamenflora*, Leipzig, 1932, **14**.

ON THE VERNALIZATION OF TUBERS OF *CYPERUS ROTUNDUS* LINN.

STOUT and healthy tubers of nut-grass were dug out and divided into two batches of 24 each, and stored separately in two bottles. 500 ml. of water was maintained in each so as to keep the tubers fully saturated. One of these bottles was kept continuously (in a Kelvinator) at a temperature of 7° C and the other in the shade at the ordinary atmospheric temperature as control.

After four weeks, the tubers were sown separately in four earthen flower pots. The pots were regularly watered to the extent of 1,000 ml. once a week. Hoeing of the pots was, however, regularly effected every Wednesday to maintain an optimum tilth of the soil.

Tubers in both the experimental and control pots germinated quite normally with a bias of earliness to the extent of 2-3 days in favour of the experimental. Subsequent performance of plants raised from the experimental tubers were definitely superior to those of the control *viz.*, they were taller, more vigorous and deeper green with broader leaf-blades. Besides, the plants from the vernalized tubers entered into the reproductive phase 30 to 31 days earlier than the control.

This little experiment, therefore, demonstrates that underground tubers, when subjected to low temperature, could be vernalized like seeds.

I am thankful to Sri. C. Lakshmanan for his help during this experiment.

Dept. of Botany, T. C. N. SINGH.
Annamalai University,
Annamalainagar, *February* 10, 1953.

1. Murneek, A. E. and Whyte, R. O., *Vernalization and Photoperiodism*, (A Symposium), Chronica Botanica Company, Waltham, Mass., U.S.A., 1948, 147-57.

OCCURRENCE OF A NEW SUBSPECIES, *OPALINA JAPONICA DHARWARENSIS*

THE Opalina described in this note was found in the rectum of the frog, *Rana limnocharis* from Dharwar and belongs to the beaked group, *Japonica*, since it has an abruptly pointed posterior end. The beak in this Opalina is similar to that found in the type species *Opalina japonica* Sugiyama, but differs from it in the following points.

(1) The nuclei are larger in size and spherical in shape; (2) The individuals are broader in form and more regularly shaped than those described in *O. japonica*; (3) Ranarum-like forms also met with in the same infection suggest the Opalina to be somewhat intermediate; (4) The body dimensions are distinctly larger.

For these points of differences the Opalina has been regarded as a new subspecies of *Opalina japonica* Sugiyama, and it has been named as *Opalina japonica dharwarensis*.

The description given for this new subspecies is based on studies both in its living condition as well as from the observations made from the smears fixed in Bouin's fluid and stained with Delafield's hematoxylin.

The figures have been drawn with the aid of a *Camera lucida*.

Opalina japonica dharwarensis nov. sub. sp.

Body is flat and thin. Anterior end is broadly rounded while the posterior tapers to an abruptly pointed end. The beak thus formed is not bent to one side like in *Opalina coracoidea* Bezz. In some individuals, this beak was found to be very much reduced or even absent. Such forms resembled the Ranarum-like forms. But their nuclei are smaller.

Therefore, the Opalina under study is an intermediate species and shows greater affinities to the Japonica group.

The thin ectoplasm is well marked off from the dense endoplasm. The spherical nuclei are uniform in size and are evenly distributed in the cytoplasm. The cilia are close-set, small and are of uniform length throughout the body-surface.

Body (length × breadth) average, of 24 individuals, 203 × 159 microns. Nucleus (diameter) 4·5-5 microns. Length of cilia 6 microns.

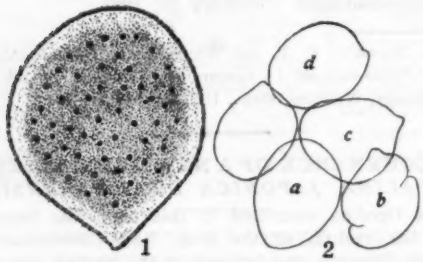


FIG. 1. *Opalina japonica dharwarensis* nov. sub. sp. in *Rana limnocharis* Wieg, from Dharwar.

FIG. 2. Individuals of the same under low power of microscope. Individual (*c*) is a Japonica-like form. Individuals (*a*) and (*d*) are Ranarum-like forms with reduced beak or none. Individual (*b*) is undergoing division.

The nearest species of this group, *Japonica* (Metcalf, 1923 and 1940) are:—*O. panamensis*, *O. drytonni*, *O. coracoidea* and *O. annandali*, the diagnostic features of which have been compared with the present new subspecies in the following table, in which all the dimensions are in microns.

	Body (L × B)		Nucleus		Cilia length
O. japonica Sugm.	Oval,	178 × 104	oval,	4 × 3·6	8
O. coracoidea Bezz.	,,	204 × 120	round (beak bent to one side)	3·5	..
O. panamensis Met.	,,	177 × 115		4·8–5	..
O. drytonni Met.	,,	170 × 120	round,	4–6	..
O. annandali Met.	rounded,	128 × 57	oval,	3·3 × 2	..
O. japonica dharwarensis nov. sub. sp.	broadly rounded	203 × 159	spherical,	4·5–5	6

The writer thanks Dr. K. R. Karandikar for providing facilities during the course of this work.

Dept. of Zoology, Karnatak College, Dharwar, *June* 21, 1952. J. C. UTTANGI.

1. Metcalf, M. M., "*The Opalinid ciliate infusorians*," *Smithsonean Inst. U.S. Nat. Museum Bull.*, No. 120, 1923. 2. —, "Further studies on the Opalinid ciliate infusorians and their hosts," *Proc. U.S. Nat. Museum*, 1940, 87.

OCCURRENCE OF YOUNG MACKEREL, *RASTRELLIGER CANAGURTA* (CUVIER) OFF MADRAS COAST

THE occurrence of young mackerel, *Rastrelliger canagurta* (*Scomber microlepidotus* of Day, 1876) which we have noticed in large numbers on 21st and 23rd March and on 20th April 1953 in the shore-seine catches on the Madras Coast is worthy of record. It is not uncommon to find young mackerel along the West Coast of India in the months of July to September (Chidambaram *et al.*, 1952; Bhimachar and George, 1952; Panikkar, 1952). The spawning habits of the Indian mackerel are not fully understood, but it is fairly clear from the various observations of previous workers that the spawning period extends from May or June to September on the West Coast. Our observations seem to be the first on record showing that young mackerel occur during March-April period along the East Coast.

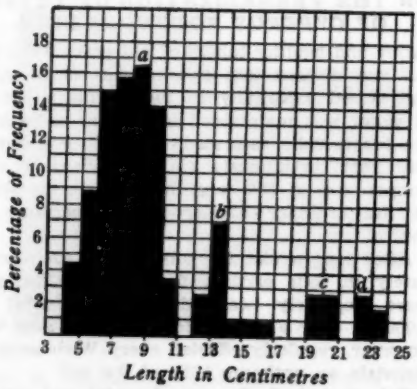


FIG. 1. Size-frequency distribution of the Indian Mackerel, *Rastrelliger canagurta* off Madras coast in March–April, 1953.

A fairly large sample of young mackerel was collected by us on 21st March 1953, when they were abundant in the shore seines amounting to 60-80 lb. in each haul. Another random sample of juvenile and adult mackerel was collected on the 17th of April 1953 from the boat-seine catches. These two samples were combined, and the whole was treated to represent the entire population of the species occurring in the inshore waters of the Madras Coast during the period of March-April under observation. It may be seen from the figure that the predominant size-group of young mackerel (*a*) is at 8-9 cm. in length, and the maximum and the minimum sizes noticed by us among this group are 10·3 cm. and 4·9 cm. respectively. The catch obtained in the boat-seines showed a wide variation in sizes ranging from 9·7 cm. to 23·4 cm. The juvenile and adult mackerel of the sample fall into three definite groups with peak values of 13-14 cm. (*b*), 20 cm. (*c*) and 22-23 cm. (*d*). There is a similarity in the occurrence of young mackerel from July to September following the south-west monsoon on the West Coast, and from March onwards following the north-east monsoon on the East Coast. One of us working at Vizagapatam on the East Coast has previously observed young mackerel varying from 10-14 cm. in June in both the years 1951 and 1952.

We are grateful to Dr. N. K. Panikkar for going through the manuscript and offering his valuable criticism.*

Central Marine Fisheries Research Unit, Madras-5, *April* 22, 1953.

K. Virabhadra Rao.
S. Basheeruddin.

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp P.O.

1. Bhimachar, B. S. and George, P. C., *Proc. Ind. Acad. Sci.*, 1952, **36**, 105-18. 2. Chidambaram, K., Krishnamurty, C. G., Venkataraman, R. and Chari, S. T., *Ibid.*, 1952, **35**, 43-68. 3. Day, F., *Fishes of India*, 1876, **1**, 250-51. 4. Devanesan, D. W. and John, V., *Curr. Sci.*, 1940, **9**, 462-64. 5. Panikkar, N. K., *Journ. Bomb. Nat. Hist. Soc.*, **50**, 741-65. 6. Rao, H. S. and Panikkar, N. K., *Proc. Indo-Pac. Fish. Council*, 1949, **1**, 117-32.

BACTERIAL LEAF-SPOT OF *CYAMOPSIS TETRAGONOLOBA* (L.) TAUB.

Xanthomonas cyamopsidis sp. nov., the pathogen causing leaf-spot on *C. tetragonoloba*, first noticed at Patna (Bihar) and Khopoli (Bombay) in September, 1952, produces several small, circular, water-soaked spots (0·25 mm. to 0·5 mm. in diam.). The spots are found all over the lamina and are olive-coloured on the upper surface with characteristic oily appearance on the under-surface. The fully developed jet black spots measure 1·5 mm. in diameter and when numerous, coalesce to form irregular lesions surrounded by chlorotic areas. Veins are also infected. In severe cases of infection, the numerous water-soaked spots on the leaves give them the appearance of boiled leaves. Such leaves dry without showing chlorosis.

Description of the pathogen.—Rods, single or in chains of two, capsulated, motile with a single polar flagellum, measure $1{\cdot}5\,\mu \times 0{\cdot}8\,\mu$; non-spore former; on potato dextrose agar plates, colonies round with entire margins, smooth, shining, umbilicate, consistency butyrous, colour sulphur yellow (Ridgway) with no striation, colony diam. 1·1 cm. after 4 days; on nutrient agar plates, growth medium, flat, smooth, glistening with lobate margins, colour mustard yellow (Ridgway), colony diameter 1·1 cm. after 6 days; in nutrient broth, fair growth within 24 hours, gelatin liquefied; starch and casein hydrolysed; litmus reduced; nitrites not produced from peptone and potassium nitrate; hydrogen sulphide and ammonia produced; 3 per cent. sodium chloride tolerant; optimum temperature for growth 25° C. to 31° C., no growth between 5° C. and 13° C., thermal death-point 52° C.; pathogenic to hairy and glabrous varieties of *C. tetragonoloba*.

A detailed account will be published elsewhere.

Plant Pathological Lab., College of Agriculture, Poona-5, *March* 4, 1953.

M. K. Patel.
G. W. Dhande.
Y. S. Kulkarni.

NEW HOSTS OF THE DOWNY MILDEW OF CUCURBITS IN INDIA

One of the most serious diseases of cucurbits in India, as elsewhere, is the downy mildew caused by the fungus *Pseudoperonospora cubensis* (B. & C.) Rost. (*Peronoplasmopara cubensis* (B. & C.) (Berl.). In describing the parasite and explaining its persistence from season to season, Butler E. J. (*Fungi and Disease in Plants*, 1918, p. 313) states "the great diversity of climate and season in different parts of India and the frequency of suitable hosts would probably ensure the continuous growth of the parasite".

The number of hosts recorded for the fungus in India is comparatively small. There is no mention anywhere in *India* of cucumbers, *Cucumis sativus*, being infected. The disease was first noticed in Mysore by the senior author on a plot of cucumbers near Bangalore towards the end of November 1927. Later, in December

1952, it appeared in a severe form on cucumbers near Bidadi, about 23 miles from Bangalore. Soon the disease spread to water melons (*Citrullus vulgaris*), sweet melon (*Cucumis melo*) and bottle gourd (*Lagenaria vulgaris*). There is no record in the literature available of *Lagenaria vulgaris* being infected anywhere in the world, and so far as India is concerned this appears to be the first notice of the fungus on *Citrullus vulgaris*.

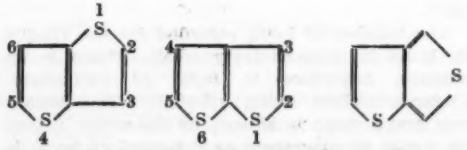
The infected vines are easily spotted on the field by the yellowish or partly dried up leaves. The spots can be readily made out when the young affected leaves are held up against the light. The nature of the fungus, and the measurements of the sporangiophores and sporangia correspond to those in literature. The sporangia are colourless when young, and purplish or violet when mature. They germinate readily in distilled water, either by putting forth germ tubes or by giving rise to zoospores. Oospores have not been noticed.

The early removal of the badly infected vines followed by spraying with 1 per cent. Bordeaux mixture prevented the spread of the disease.

Lab. of Plant Pathology,
Dept. of Agriculture,
Bangalore, S. V. VENKATARAYAN.
March 7, 1953. N. S. VENKATAKRISHNIAH.

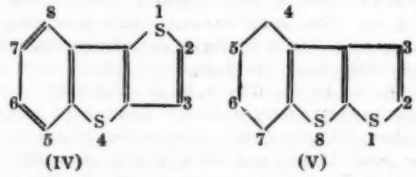
SYNTHESIS OF THIOPHTHENES

THE synthesis of a solid and a liquid thienothiophene (Thiophthene) by the action of acetylene on molten sulphur has been described in the literature.[1,4] The solid isomer was constituted as thieno(3 : 2-*b*)thiophene (I) because of its zero dipole moment and the liquid isomer was constituted as thieno(2 : 3-*b*)thiophene (II) because of its alternative synthesis from tricarballylic acid or citric acid by the action of phosphorus trisulphide.[2] Whereas the zero dipole moment of the solid isomer confirms its structure (I), the liquid isomer may be constituted either as (II) or (III). The structures (I) and (II) assigned to thiophthenes have now been confirmed by unambiguous synthesis following the general method for the synthesis of thiophenes and thiapyrans described by us earlier.[3]



(I) (II) (III)

Condensation of 3-thiophenethiol with bromoacetaldehyde diethyl acetal in alcoholic sodium ethoxide solution gave 3-thienyl ω-diethoxyethyl sulphide, b.p. 115-20° (bath temp.)/1 mm. (2 : 4-dinitrophenylhydrazone, m.p. 113°). Cyclization of the latter with phosphorus pentoxide in boiling benzene gave (I), m.p. 55° (Challenger and Gibson[4] give m.p. 54°) (picrate, m.p. 146°). 2-Thienyl ω-dimethoxyethyl sulphide, b.p. 120-24° (bath temp.)/1 mm. (2 : 4-dinitrophenylhydrazone, m.p. 115°), prepared similarly from 2-thiophenethiol and bromoacetaldehyde dimethyl acetal, gave on cyclization (II), b.p. 75-80° (bath temp.)/1 mm. (Challenger and Gibson[4] give b.p. 224-26°) (picrate, m.p., 135-36°; Biedermann and Jacobson[2] cite m.p. 133°).



(IV) (V)

With the possible exception of thionaphtheno (3 : 2-*b*)thionaphthene, other condensed ring systems containing (I) are unknown. None of the derivatives of (II) have likewise been reported. Thieno(3 : 2-*b*)thionaphthene (IV), m.p. 87-88° (*sym*-trinitrobenzene derivative, m.p. 135°) and 4 : 5 : 6 : 7-tetrahydrothieno (2 : 3-*b*)thionaphthene, b.p. 130-40° (bath temp.)/1 mm. (V) (*sym*-trinitrobenzene derivative, m.p. 106-07°) have now been prepared, starting from 2-bromocyclohexanone and 3-thiophenethiol and 2-bromocyclohexanone and 2-thiophenethiol respectively. The different steps in the synthesis of (IV) and (V) were similar to those employed by us earlier for the synthesis of dibenzothiophenes.[5]

Details of the work will be published shortly elsewhere.

Dept. of Chemical Technology, V. V. GHAISAS.
University of Bombay, B. D. TILAK.
Matunga, Bombay-19,
May 22, 1953.

1. Capelle, *Bl.*, 1862, (4) **3**, 151 (cited from Beilstein, 1934, **Bd. 19**, 18. 2. Biedermann and Jacobson, *Ber.*, 1886, **19**, 2445. 3. Tilak *et al.*, *Proc. Ind. Acad. Sci.*, 1950, **32A**, 390, *et sequa.* 4. Challenger and Gibson, *J.C.S.*, 1940, **305**. 5. Rabindran and Tilak, *Proc. Ind. Acad. Sci.*, 1952, **36A**, 411.

REVIEWS

Television. By F. Kerkhof and W. Werner. (Philips Technical Library, Eindhoven, Holland), 1952. Pp. 434. Available with Philips (India), Calcutta.

The reader of this book is assumed to possess a good knowledge of basic radio engineering. With such a background, he will quickly grasp the physical fundamentals of modern television circuits and of new circuits still to be developed. It is an advantage that the authors use exclusively the rationalised MKS system of units and avoid confusing terms such as "frame". Preference is given to the receiving side of television systems, but the essential features of transmitting and studio technique have also been mentioned.

The first 16 pages describe the basic principles of TV-transmission, involving scanning systems, propagation problems, and block-schemes of a transmitter and a receiver. An experienced radio engineer will immediately understand the difference between TV-technique and sound broadcasting technique.

Chapter II deals with the movement of electrons in electric and magnetic fields. The chapter begins with a theory of electron deflection. The basic electronoptical fundamentals of electric and magnetic focusing are only introduced thereafter. This procedure might present difficulties to readers not previously familiar with the science of electron optics. Some topics, like cycloidal movement or optical aberrations, could easily have been omitted. The rest of the chapter brings the fundamental equations for magnetic focussing and magnetic and electric deflection. Well-selected examples demonstrate the practical use of these equations for design problems.

A descriptive introduction to the physical principles of various types of pick-up tubes and picture tubes is the subject of Chapter III. It is followed by a chapter on the details of the TV signal as standardised in U.S.A. and Europe containing also an introduction to pulse transmission, D.C. restoration and pulse separation circuits. The excellent discussion of pulse top compensation by balancing the time constants of "grid leak resistance-coupling capacitor" on one side to the "load resistor-by-pass capacitor" on the other side will rarely be found anywhere else in the TV literature.

Chapter V is a successful attempt to explain the basic principles of pulse technique and at the same time to insert as much design information as may help a beginner in TV circuit technique to check his designs numerically. To do this task in less than 50 pages is not easy. The authors have to be congratulated on their well balanced compromise between descriptive presentation and exact derivation of fundamental equations. A slightly more extensive use of waveform diagrams with typical numerical values of voltages and currents might be appreciated by practical designers.

Chapters VI and VII come up to a level which might not be expected in a general text-book on television and it is here that the reader most gratefully will observe the contribution of the authors to recent TV developments. The current time-base and the fly-back (or kick-back) EHT power supply are two problems of a TV receiver, which are still considered to be full of magic. They are generally dealt with in 3 to 4 pages even in up-to-date text-books. But here we find 52 pages of extensive treatment with plenty of extremely useful diagrams and design formulæ.

Chapter VIII on wide-band amplifiers constitutes the most valuable part of the book and even specialists in this branch will enjoy the more than 100 pages of carefully selected material. All types of amplifiers (video, carrier, single stage, multi-stage) with all possible kinds of frequency compensation are completely covered, using both approaches, frequency spectrum and time function.

Chapter IX could have been omitted, as so many text-books on radio or electric circuits cover the principles of transmission lines in the conventional form. Instead, it might have been more useful to extend Chapter X on aerials. The inclusion of more design data for wide-band receiving aerials, particularly in the *u.h.f.* range, would be welcome.

The optical fundamentals revised in Chapter XI, favouring the needs of TV-projection systems, will be very useful to many readers. The short pre-view (Chapter XII, 8 pages) on colour TV should not be missed. In the concluding Chapter XIII, all the previously discussed single circuits are composed to form a complete TV receiver. Two complete receiver diagrams with numerical values for all the components are discussed as examples. One is for

the British standard (positive modulation), the other for the Continental standard (negative modulation).

Sixteen highly instructive photographs from actual TV pictures taken under various faulty operating conditions conclude the excellent book, which can be strongly recommended to any radio engineer or technician, interested in learning the full details of the new art of television.

R. FILIPOWSKY.

Television Receiver Design. By A. G. W. Uitjens. (*Monograph* 1, *I. F. Stages.*) (Philips Technical Library, Book VIII A). Distributed in India by Philips House, Calcutta 20. Pp. 188 + 150 illustrations. Price Rs. 14.

This book is the first of a series recently started under the common title "Television Receiver Design" which again is part of the big series of Philips' books on "Electronic valves". Apart from this series Philips has already published the book *Television* by Fr. Kerkhof and W. Werner as a general introduction to the subject. Even the most careful study of this or any other book on TV principles leaves the reader with the desire for more detailed information on some of the subjects. The present series is intended to fulfil this need.

It is not accidental that the first book of the series deals with carrier wide-band amplifiers, primarily with TV-i.f. amplifiers. This branch of TV design technique is at least in its basis closely related to the conventional i.f. technique. However, the absolute values of the components involved and the design formulæ to be derived and used are considerably different from those familiar to a radio engineer.

The whole treatment is centred round the "gain bandwidth" produced, thus permitting a comparison between the various interstage coupling systems. TV-i.f. amplifiers in receivers involve generally 4 or 5 i.f. stages, as compared with only 1 or 2 in radio receivers. The problem of the multi-stage amplifier deserves, therefore, the greatest attention and the most perfect solution is presented by the "stagger tuned system" of amplifier design. Large parts of the book are devoted to it.

A valuable tool for evaluating TV-amplifiers is the step-function response, to which nearly the entire Chapter III (pp. 23-48) is devoted. Much new material, not published in book form anywhere else, is included in this section which, however, avoids excessive mathematics, and is suitable for the general reader.

The second half of the book deals with noise problems and feedback in an excellent presentation of the rather difficult matter. Many new details will be found in these 70 pages, specialists included.

A good appendix gives exact mathematical proofs to many of the newly introduced formulæ, besides a large number of charts and numerical data of the most frequently needed functions.

The book can be heartily recommended to all TV designers or engineers concerned with wide-band amplification in other fields.

R. FILIPOWSKY.

The Molecular Architecture of Plant Cell Walls. By R. D. Preston. (Chapman & Hall), 1952. Pp. xii + 211. Price 36 *sh.*

This book is mainly a connected account of the studies made by the author and his collaborators on the structure of plant cell walls. The first five chapters covering about half the book forms an introduction, giving the essential physics, chemistry and botany needed for a proper appreciation of this work. The treatment in these chapters is necessarily cursory, although a number of references are given which the interested reader may consult for more details. The studies are concerned with the nature of organization of cellulose chains in the wall structure of plant cells. Both X-ray and optical methods are used for this purpose, and it is interesting to read how the results of one can be used to supplement or confirm those obtained from the other. The use of crystal optics as an aid to the analysis of crystal structure has not been appreciated as much as it ought to be, and it is noteworthy that Dr. Preston has laid particular emphasis on the use of optical methods with polarized light in these investigations.

The detailed study of the orientation of cellulose chains throughout the area of a cell wall is a laborious process, but it does yield some very interesting results. For instance, the wall structure of a *Valonia* vesicle is found to consist of a cellulose spiral starting from a pole at one end and ending at the other end with cross striations throughout the length of spiral. In another alga, *Cladophora*, the cellulose chains form a criss-cross pattern, whose inclination to the axis of the plant stem varies in a characteristic manner from the base of the plant upwards. Another study deals with the angular dispersion of cellulose fibres in various woods. An excellent series of X-ray photographs have been obtained in this connection using spirals made from well-oriented artificial silk, which reproduce most of the effects actually found.

One is left with the impression that the contents of the book are more in the nature of a review of the author's reasearches, rather than on account of the subject as a whole. However, the book contains a large amount of valuable information, and botanists and physicists alike will profit by reading through it.

G. N. RAMACHANDRAN.

A Treatise on Physical Chemistry, Vol. II. (*States of Matter.*) Edited by H. S. Taylor and S. Glasstone. (Macmillan & Co., London), 1951. Pp. v + 701. Price 75 *sh.*

This is the second volume of the compendium on physical chemistry whose scope "was to be so broad that the student in a special field could garner from its pages that which was known as he set forth in his quest for the unknown". It deals with the kinetic theory of gases and the properties of both ideal and imperfect gas systems, the liquid state, the structure of solids as revealed by X-rays and the properties of matter in the colloid state. Each field is covered by specialists fully conversant with it, and the treatment is critical and thorough, while at the same time, brief and to the point. The discussion is not restricted to recent developments, although naturally they occupy the pride of place, but the whole subject is treated coherently from the beginning so that no other references need be made except for obtaining further information. The references to original literature seem to be comprehensive, although not exhaustive, the idea being probably that one could use those given as starting points for obtaining a complete bibliography. However, it is felt that a fairly complete list of the text-books and the more important reviews in each field should have been added to *every* chapter. Such a list is given for the Kinetic Theory of Gases and for the Colloid State, but is definitely needed in the chapter on X-ray analysis of the solid state.

There is no doubt that the aim of the editors stated earlier has been fully fulfilled and that in so far as the actual contents are concerned, this volume contains the most authoritative, up-to-date and comprehensive treatment that is available at present. Further volumes in this series will be eagerly awaited by chemists and physicists alike.

G. N. RAMACHANDRAN.

Typical Means. By K. Chandrasekharan and S. Minakshisundaram. (Oxford University Press), 1952. Pp. 139. Price Rs. 22-8-0.

This book inaugurates the series of Monographs on mathematics and physics launched by the Tata Institute of Fundamental Research, Bombay, mainly for the use of research workers. It comprises some important work on typical means hitherto available only in research periodicals and forms a valuable supplement to the Cambridge Tract by Hardy and Rietz on the general theory of Dirichlet series. Written by two eminent mathematicians of this country whose own contributions in this field are quite significant, it is bound to acquire a distinguished place in the literature of summablity.

An extensive theory has developed since the introduction of 'typical means' by Marcel Rietz more than forty years ago for the summation of divergent series. The book under review is a laudable attempt to give a systematic account of this development. It proceeds in four chapters, the first two of which are devoted to an exposition of the theory of typical means. Chapter I introduces the notions of summability by Rietz's typical means and of absolute Rietz summability due to Obrechkoff, and establishes, for the former, the first theorem of consistency, a limitation theorem and some Tauberian theorems. The analogue of the first theorem of consistency for absolute Rietz summability concludes the chapter.

Chapter II discusses the second theorem of consistency for Rietz summability with a classification of the different versions of this theorem due to Hardy, Zygmund and Hirst. Chapter III deals with the applications of the theory to Dirichlet series, giving Abelian theorems as well as some new converse theorems on the abscissæ of summabilities, theorems on the behaviour of a Dirichlet series on the line of summability, Tauberian theorems for Dirichlet summability and many new theorems on the Dirichlet product of summable series. The last chapter is concerned with the application of Rietz's means to the study of spherical summation of multiple Fourier series largely due to Bochner and Chandrasekharan, and it is based on a formula of Bochner which may be regarded as a generalisation of the classical integral of Fejér. It commences with the notion of spherical summation of multiple Fourier series and series derived therefrom, leading to applications to summations over lattice points in k dimensions and to a solution of the problems of ordinary and absolute summabilities discussed in the case of single Fourier series by Hardy, Littlewood and others.

The printing and get-up of the book are excellent. The notes at the end of each chapter with references brought up-to-date compensate for the lack of an index and a bibliography.

T. S. N.

The Chemistry of Synthetic Dyes, Vol. II. By K. Venkataraman. (Academic Press Inc., New York), 1952. Pp. xv + 705-1,442. Price $ 15.00.

Volume I containing the first 22 chapters was reviewed in an earlier issue of the *Current Science* (June 1952, p. 173).

Volume II is a continuation of Vol. I and contains Chapters XXIII to XLII and the index for both the volumes. Chapters XXIII to XXVI deal with diphenyl and triphenylmethane dyes, xanthine and acridine dyes, azine dyes, and benzophenone, benzoquinone and naphthoquinone dyes. Appropriate to their importance, anthraquinone dyes of various categories occupy the following six chapters covering 200 pages of the volume. Indigoid dyes, solubilized vat-dyes, sulphur dyes and sulphurized vat dyes are dealt with in Chapters XXXIII to XXXVI. Then follow two interesting chapters on phthalocyanines and cyanine dyes. Chapter XL gives an account of "The Action of Light on Dyes and Dyed Fibres", Chapter XLI "Chemical Constitution of Dyes in Relation to Substantivity" and Chapter XLII "Identification, Analysis and Evaluation of Dye Stuffs". A critical and interesting account of chromatography is included in the last Chapter.

Among the special features of the volume, the following may be mentioned: (1) The volume is eminently readable; (2) Though the scope of the book is to deal with the chemistry of synthetic dyes, other interesting properties of these dyes and related substances such as medicinal and bacteriostatic properties and uses are also described; (3) A very good account is also given of the naturally occurring groups of compounds related to synthetic dyes, such as flavones, xanthones, naphthoquinones and anthraquinone derivatives; (4) Particularly informative and lucid accounts of the properties and reactions of various groups of compounds and the comparative merits of different dyes are presented.

The index which comes to 90 pages is quite comprehensive. The printing is uniformly good and the reviewer could see only one blemish on page 821. There is no doubt that the two volumes provide a comprehensive account of the chemistry of synthetic dyes in a lucid and critical manner and constitute an essential addition to chemical literature worthy of all libraries, institutional as well as private.

T. R. S.

Ferrous Analysis (*Modern Practice and Theory*). By E. C. Pigott. (Chapman & Hall, Ltd., London), 1953. Pp. 690. Price 84 *sh.*

The author's standard text-book on "Chemical Analysis of Ferrous Alloys and Foundry Metals", has been entirely re-written and doubled in length to form the present comprehensive work.

Section I reviews the main quantitative techniques comparing gravimetric, volumetric, colorimetric, polarographic and spectrochemical methods, which incorporate two detailed chapters dealing with photoelectric absorptiometry and spectrography and reports the most recent development upto the direct reading spectrograph.

In Section II the most common methods of analytical determinations are compiled for 31 constituents occurring as alloying elements or impurities in iron and steel. The selection is fairly complete and only a few elements are missing, such as calcium and magnesium, out of which the latter one has gained importance in the production of nodular cast iron. The chapter provided for each element is introduced by brief remarks about its recovery and its effects in iron and steel. This gives a useful guidance to the analytical chemist regarding the usual concentrations of the constituents. A discussion of the chemical properties and of the procedures for qualitative approach follows. The descriptions of the methods for quantitative determination are supplemented by an explanation of the basic theories and always note very carefully the time required and the accuracy attainable. Such data although very helpful, are frequently omitted in other analytical handbooks because of uncertainties. The simpler and more recent methods for oxygen and nitrogen determination are not included. Each chapter concludes with a bibliography of ferrous analysis research published since 1930. This section represents the most comprehensive part of the book taking 486 pages.

Section III devoted to microchemical analysis describes the special equipment and the methods for micro-determination, further specific spot reactions, examination of unisolated inclusions and finally micro-analysis of isolated inclusions. The very recent attempts to investigate into the compositions of isolated carbides and nitrides are not yet considered.

Section IV reporting on the analysis of ferro-alloys, iron ores, aluminium and copper alloys and Section V reporting on the analysis of refractory materials should only be regarded as an extract from a more extensive field.

Out of the four appendices the one concerning the rapid analysis of ferrous bath samples is of practical interest. Regarding the time required for determination of phosphorus and sulphur, agreement exists with common steel plant experience. For silicon, the time indicated is too large, while for carbon and manganese, it is smaller than what is generally achieved.

The book is designed both for the practising analyst and the advanced student and may definitely be estimated to serve this purpose well. It forms a valuable addition to the existing literature on metallurgical analysis and hence can be recommended to all interested in the subject. H. SCHRADER.

Electrical Units, With Special Reference to the M.K.S. System. By Eric Bradshaw. (Chapman & Hall, Ltd.), 1952. Pp. 64 + 9 figs. Price 9 *sh.* 6 d.

The first two chapters contain a review of the essential mechanical units and the notions of primary units and derived units. The important classical systems, *viz.*, the C.G.S. electrostatic system of units, and the C.G.S. electromagnetic are then considered and the M.K.S. rationalized system is introduced as an extension of the practical units. In order to explain the advantages of this system, the main steps in the establishment of the basic relations of electrotechnics have been outlined by the author. He recommends the adoption of the primary units: metre, kilogram, second and ampere, but suggests that all derived electrical units may be conveniently described in terms of A, V, *m* and sec., or derivatives of these. Conversion tables, copious examples from electrical engineering, and a brief reference to two-dimensional field plotting, help to clarify certain ideas about fields and the associated units of measurement and emphasize the value of a rationalized (particularly the M.K.S. rationalized) system of units. The publication is a further recommendation of the "Rationalized M.K.S. or Giorgi System of Units" advocated by the reviewer, for which he has suggested the simple name "Electrical Units". R. W.

Progress in the Chemistry of Fats and Other Lipids, Vol. I. Edited by R. T. Holman, W. O. Lundberg and T. Malkin. (Pergmon Press, Ltd., London), 1952. Pp. 186. Price 42 *sh.*

This volume is the forerunner of "completed and projected manuscripts to be published in the form of an annual Progress Series". The five articles in the volume were originally intended for a new edition in English of the Hefter-Schoenfeld "Chemie und Technologie der Fette und Fetteprodukte", a project which had to be abandoned due to the untimely death of Dr. Schoenfeld. These are: 'The Molecular Structure and Polymorphism of Fatty Acids and Their Derivatives' (T. Malkin); 'Sterols' (Werner Bergmann); 'Structure and Properties of Phosphatides' (P. Desnuelle); 'Chromatography of Fatty Acids and Related Substances' (R. T. Holman); and 'Derivatives of the Fatty Acids' (H. J. Harwood).

No doubt, most of the material covered by the above articles has already appeared in greater detail in recent text-books by Bailey, Danel, Markley, Ralston and Wittcoff. However, these articles offer an up-to-date but concise survey of the subjects, and their value has been increased by a critical appraisal of the work done so far, trend of recent research and suggestion for further work in the fields concerned.

Several typographical errors are noticed in the book which otherwise is neatly printed and bound. Authors' names have been arranged alphabetically under "References" only in one chapter out of five. Names under "Name Index" give cross-references to names under "References" and not to the text proper. Considering that the book has only 186 pages, the price is somewhat high. J. G. K.

Mass Spectroscopy in Physics Research, *Proceedings of Symposium held in September, 1951.* (National Bureau of Standards Circular No. 522). (Order from Government Printing Office, Washington 25, D.C.). Pp. 273. Price $ 1.75.

During the past decade, mass spectroscopy has assumed an important role in both physics and chemistry for research and analytical work. Although several chemistry conferences have touched on these topics, the Bureau's Symposium on Mass Spectroscopy in Physics Research provided physicists with their first comparable opportunity to discuss advances in mass spectroscopy, particularly interesting to them and to derive thereby the longer range benefit of personal contacts with leading workers in this field.

Papers presented by outstanding physicists from many laboratories throughout the United States and ten other countries at this symposium are included in this volume, and in most cases a fairly complete record of the discussions following the papers is given. Thus, the circular summarizes a decade of work in mass spectroscopy and its use in physics research.

Botany of Sugarcane. By C. Van Dillewijin. (Chronica Botanica, Waltham, Mass, U.S.A.), 1952. Pp. xxiii + 371. Price $ 6.00.

This book from the pen of a veteran worker on sugarcane is a comprehensive compilation of the present stage of knowledge about this plant. It is divided into two sections—one dealing with morphology and anatomy, and the other with physiology. The author has adopted the method of literally citing salient parts of original articles and dividing and subdividing the contents to facilitate quick reference. But it is obvious that such a method would allow little scope for critically evaluating divergent findings in the light of the experience of the author, and often gives an air of finality to findings which subsequent work has failed to uphold.

In the section of botany (constituting one-fifth of the book), a chapter might have been added on taxonomy of sugarcane and other species of saccharum so often referred to, and on allied genera, *viz.*, Erianthus, Narenga, Sclerostachga which together are known as wild saccharums. The subject of "Inflorescence" also deserved a more detailed treatment. Physiology of sugarcane has been treated comprehensively, with well-written chapters on various important aspects giving all that one needs to know in outline. Trace elements, however, have not received the attention they deserve and certain elements, such as zinc and molybdenum, find no mention at all. A chapter on physiology of flowering would have enhanced the value of the book and one would have also liked to find a mention of "pith" and "cavity" and an empirical formula for determining size of leaf, besides a list of important varieties (past and present) grown in different countries along with their parentages.

The book is written in lucid style and is profusely illustrated with useful graphs, diagrams and histograms supplemented by numerous tables and an exhaustive bibliography. It is on the whole, a herculean effort on the part of the author who deserves the gratitude of workers in sugarcane for compressing such a vast amount of knowledge into one book of moderate size. It will doubtless prove useful as a reference work both in laboratory and field investigations on sugarcane, and should most legitimately find a place in the library of all research institutions and on the shelf of all workers connected with problems of sugarcane and its cultivation. Its austere and elegant get-up is of a piece with its contents.

K. L. KHANNA.

Physiology of the Fungi. By Virgil Greene Lilly and Herace L. Barnett. (McGraw-Hill Book Co., New York), 1951. Pp. xii + 464. Price $ 7.50.

The present volume bears sufficient evidence of the influence of biochemistry on the study of the fungi. A little more than two-thirds of the book is devoted to the biochemical aspects of the problem, perhaps at the cost of the systematics of fungi.

The book opens with a brief introduction explaining the scope and aim of the authors in this project. The earlier chapters relate to culture media and growth. This is followed by the biochemical aspect detailed in the next eleven chapters under enzymes, essential elements, etc. The physiology of the fungi is dealt with in the last five chapters, with special reference to sporulation, spore germination, physiology of parasitism and inheritance, and variation.

The appearance of the present volume is timely, and the able handling of all the topics makes the book a useful addition to all students in this field of fungi.

T. N. R. RAO.

Books Received

Code for Protection against Lightning. (N.B.S. Handbook No. 46 of 10-12-1952.) Pp. x + 88. Price not given.

Blood Cells and Plasma Proteins. Edited by James L. Tullis. (Academic Press Inc., New York, N.Y.), Number 2, 1953. Pp. xxii + 436. Price $ 8.50.

Advances in Cancer Research, Vol. I. Edited by Jesse P. Greenstein and Alexander Haddow. (Academic Press Inc., Publishers, New York). Price $ 12.00.

Field Experimentation with Fruit Trees and Other Perennial Plants. By S. C. Pearce. (Technical Communication No. 23 of the Commonwealth Bureau of Horticulture and Plantation Crops, Farmhouse, Bucks, England). Pp. x + 130. Price 10 *sh.*

Radio Engineering, Vol. 2. By E. K. Sandeman. (Chapman & Hall, Ltd., 37, Essex Street, London W.C. 2), 1953. Pp. xxii + 612. Price 55 *sh.*

Essays in Marine Biology. (Richard Elmhirst Memorial Lectures). (Oliver & Boyd, Edinburgh). Pp. viii + 144. Price 12 *sh.* 6 *d.* net.

Soil Blocks. (John Innes Leaflet No. 12). (Oliver & Boyd, Ltd.), Feb. 1953. Pp. 8. Price 9 *d.*

Sound. By Singh and Prakash. (Kishore Publishing House, Parade, Kanpur), 1952. Pp. viii + 319. Price Rs. 7-8-0.

SCIENCE NOTES AND NEWS

Wax Plates for Reconstruction of Models from Serial Sections

Shri. H. Swarup, Zoological Laboratories, Saugar University, Saugar, writes as follows: Among the substances used for the reconstruction of models from serial sections, a mixture of bees' wax and paraffin wax (m.p. 58°-60° C.) in equal proportions was found most satisfactory. This mixture is heated till it begins to boil and is then poured over a clean sheet of glass, the surface of which has been coated with a very thin layer of glycerine. The glass plate is kept cool by a layer of cold water below it. While pouring the boiling wax, the following precautions are necessary: (1) The glass plate should be kept on a perfectly horizontal and smooth surface; (2) The same quantity of boiling wax should be poured on the glass plate every time; (3) Each time the boiling wax is poured, care should be taken that it spreads uniformly on a measured area of the glass plate. For a plate 1 mm. thickness and area of 300 sq. cm., 28 g. of wax was found necessary. *Camera lucida* sketches of sections are drawn directly on the wax plates and subsequently cut out with the help of a warmed needle. The cut out sections, after being placed one above the other, can be cemented by passing a hot scalpel round the cut edges. In this way, excellent, true-to-scale models can be prepared easily.

Absorption of Moisture by Plants from Dew and Fog

In a research report read at the meeting of UNESCO's Advisory Committee on Arid Zone Research which opened in Paris on May 11, Dr. F. W. Went, Director of the Earhart Plant Research Laboratory of the California Institute of Technology, reported the discovery that dew is an effective source of moisture and can be stored in the soil by certain plants. Working under a grant from UNESCO, Dr. Went and Mr. S. Duvdevani, of Israel, found that a plant that has wilted from lack of soil moisture can not only absorb sufficient water at night through the leaves to sustain it through a succeeding hot and dry day, but can actually excrete water through the roots into the soil and thus use the soil as a reservoir for moisture. With tomatoes, peas, sugar beats, squash and mint the amount of water thus passed to the soil in a single night occasionally exceeds the weight of the plant itself. Studies are now continuing on other plant varieties to measure their relative efficiency. This discovery offers the possibility of successful vegetable growth in semi-arid areas that are subject to night fogs and dew, as is the case in some parts of Morocco. Dr. Went has recommended an intensive survey of the frequency and the amount of dew in all the semi-arid areas of the world, in order to test the efficacy of food production under dew.

Magnets from Superfine Iron Powder

Under the name Gecalloy, the General Electric Co., England, has developed a technique for making magnets from iron powder (1/1,000th the diameter of the finest radio iron powder). Gecalloy micropowder magnets can be made in a variety of shapes by the use of special press tools and power presses. Strength for strength, a Gecalloy magnet weighs only approximately half as much as a conventional steel magnet. The ability to mould magnets by processes akin to those used in plastic moulding, therefore, opens up the way for entirely new conception for electrical machines. As every individual particle can be insulated from its neighbour, the Gecalloy is in effect an insulator. There are thus no eddy currents when it is used in an inductive device.

Film on Dental Cement

A 16 mm. film produced by the National Bureau of Standards and the Council on Dental Research of the American Dental Association demonstrates a new method of mixing silicate cements in a closed container whereby the maximum amount of powder is incorporated into a given quantity of liquid independent of atmospheric conditions. Actual restorations in the mouth demonstrate the value of these findings in dental practice.

This film may be obtained on loan or purchase by application to the Office of Scientific Publications, National Bureau of Standards, Washington-25, D.C., or the American Dental Association, 222, East Superior Street, Chicago 11, Illinois.

Molybdenum Disulphide as Lubricant

Pure molybdenum disulphide is being recommended for use as a dry lubricant since it is

capable of withstanding extremely high pressures without galling or seizing. In addition it is suitable for work at both high and low temperatures, at high speeds and in a vacuum. Unlike many other lubricants, it has good chemical and thermal stability and the lubricating properties appear to be unaffected in the range between — 40° F. to 70° F. The values of the coefficient of friction of molybdenum disulphide fall between 0·05 to 0·095 while the corresponding values for graphite are 0·11 to 0·19.

Standard for Analysis of Iron and Steel

The Indian Standards Institution has brought out a standard, prescribing the analytical procedures for determining carbon, silicon, manganese, sulphur and phosphorus in iron and steel. In preparing this standard, the ISI Committee has kept in view the facilities available in the country for the necessary chemical analysis as also the technological methods followed in this field.

Radio-Telescope for Manchester

The world's largest radio-telescope is being erected at Manchester University's experimental station at Jodrell Bank, Cheshire. The telescope, which is expected to be ready for use by next year, is automatically provisioned to follow the course of the stars and may well be instrumental in compiling a new map of the heavens.

National Botanical Garden, Lucknow

The Council of Scientific and Industrial Research has taken over the Sikandrabagh Botanical Garden of the U.P. Government at Lucknow, for developing it as a National Garden. Prof. K. N. Kaul, Professor of Botany, Government Agricultural College, Kanpur, has been appointed as its Director.

Light Ray to Lure Fish

Fish are known to be attracted by light, and the new combined sinker and lure represents the first attempt to exploit this attraction for commercial fishing. The device is in the form of a hollow brass sinker with a small chamber for a dry battery and bulb. There are two apertures through which the light is beamed for a distance of several yards. It can function at a depth of up to about 400'. It was first tested during the Lofoten fisheries last spring with very encouraging results, reports the Norwegian Export Council. The cost of the light-ray fishing sinker is 30 shillings.

Institution of Chemists, India

An examination for the Associateship of the Institution of Chemists (India), Group A (Analytical Chemistry), will be held in November 1953. The last date for receiving applications for admission to the Associateship Examination is 31st July 1953. Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Botanical Society of Bengal

At the Seventeenth Annual General Meeting of the Botanical Society held recently, the following Office-bearers were elected for the year 1953-54: *President*: Dr. J. C. Sen Gupta; *Vice-Presidents*: Dr. K. P. Biswas and Prof. P. C. Sarbadhikari; *Hony. Secretary*: Sjt. Mridula Datta.

Indian Dairy Science Association

At the Sixth Annual General Body Meeting of the Association held recently, the following Office-bearers were elected for 1953: *President*: Sardar Bahadur Sir Datar Singh; *Vice-Presidents*: Dr. K. C. Sen and Mr. H. Holck-Larsen; *Joint Secretaries*: Dr. H. Laxminarayana and Mr. M. K. Sastry; and *Editor*: Dr. K. C. Sen.

In the essay competition held in 1952 (Subject: Production and Marketing of Ghee in India) Sri. K. P. Sinha and Sri. B. S. Baliga were awarded gold and silver medals (donated by Sri. G. W. Chandiramani, M/s. Sheile & Co., Bangalore), respectively for their essays.

Dr. Harold Lyons

Dr. Harold Lyons, Research Director, National Bureau of Standards, U.S.A., was recently honoured by the Washington Academy of Sciences, for his invention of the atomic clock, which is accurate to within 1 in 10^{10}.

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